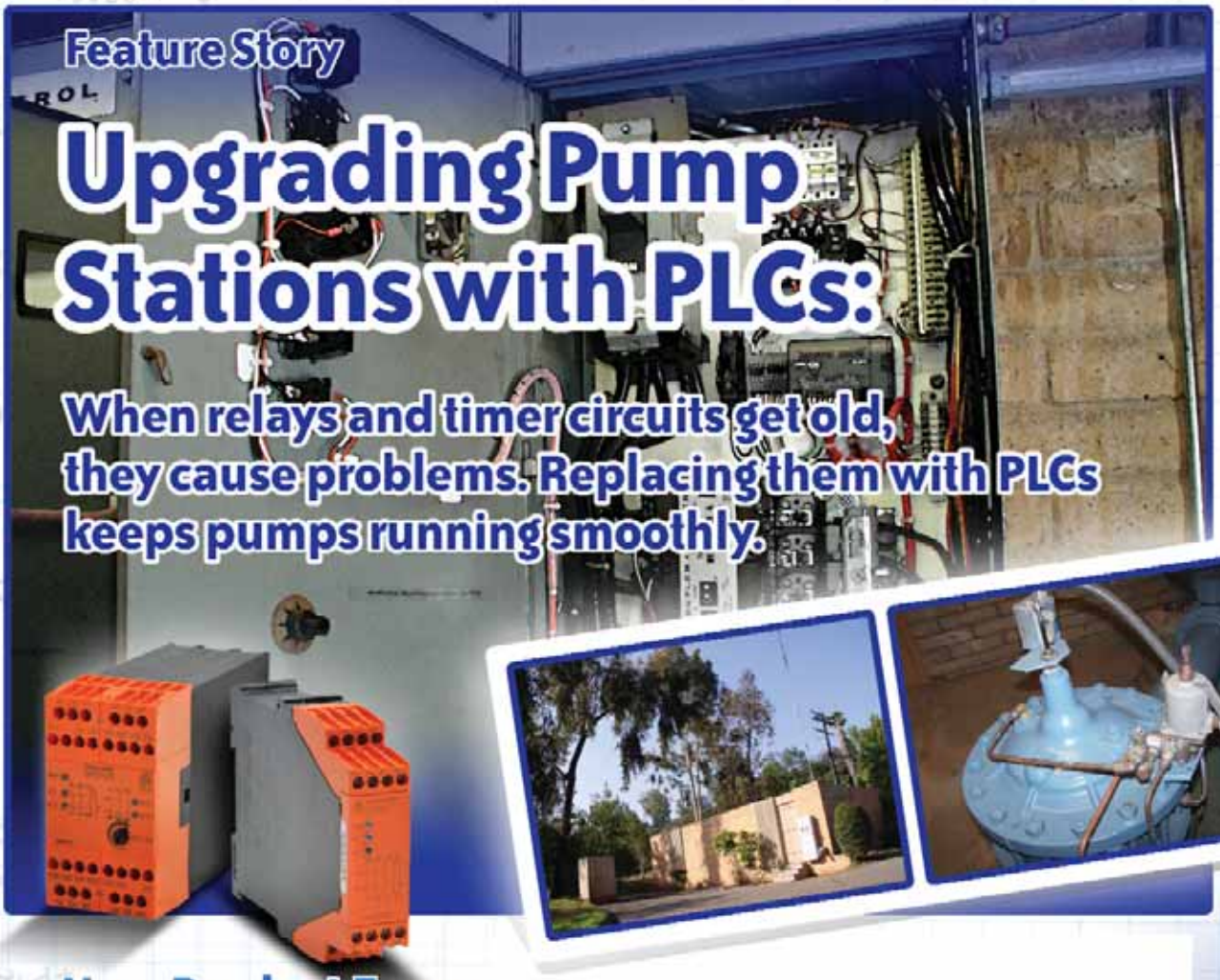
Your guide to practical products, technologies and applications

Automation NOTEBOOK®

Summer 2011 Issue 20



Feature Story

Upgrading Pump Stations with PLCs:

When relays and timer circuits get old, they cause problems. Replacing them with PLCs keeps pumps running smoothly.

New Product Focus

Dold safety relays now available

User Solutions

House Theater of Chicago

Technology Brief

Top 10 Tips: Specifying VFDs (Part one of a two-part series)

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For those who prefer to speak with us in person, please call 1-800-633-0405 x1845. Thanks for your interest, and we look forward to hearing from you.

Editor's Note

We hear in the news every day about skyrocketing gasoline prices. As fuel prices continue to soar, we also hear of new ways people are conserving. More people are telecommuting more often to save money. Others are finding more fuel efficient modes of transportation. They take the bus or train more often. Others choose to carpool. Many are buying alternative fuel vehicles. Whether it's biodiesel or electric energy, if it reduces the amount of gasoline being used, we're all becoming more open to the idea of not only saving money but also saving our energy resources. In what ways are you conserving?

Do any of your energy-saving applications use AutomationDirect products? We'd love to hear about them. Drop us a line explaining your industrial processes. You never know, your story just might find its way onto the pages of a future issue of Automation NOTEBOOK.

This issue of NOTEBOOK is filled with interesting articles and bits of information that just might inspire you to try something differently. We have lots of information regarding our newest products. An informative application story shows us how a theater group in Chicago used pneumatic cylinders to tell their story. Our Student Spotlight section provides details about a group of kids using our products to help capture energy from the sun.

There's a lot more, including the ever-popular Breakroom. Test your wits to see if you can solve the mind teasers. But, most of all sit back, relax, and turn the page…

TJ Johns
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New Product Focus

what's new

Dold safety relays now available

AutomationDirect's safety product line now includes Dold safety relay devices for use in industrial applications. Used in conjunction with our light curtains and safety limit switches, these relays offer reliable control for machine safety applications.

LG5924 Series relays are single-channel E-stop relays designed to protect people and machines in applications with emergency stop buttons. Available with 24 VDC, 110 VAC, and 230 VAC coil voltages, the Category 2-rated relays are equipped with internal positive temperature coefficient resistor short circuit protection. Output configuration options include either two normally-open contacts, or three normally-open and one normally-closed contact. The normally-open contacts are safety contacts. Prices for LG5924 series safety relays start at $88.

LG5925 Series relays are dual-channel E-stop/safety gate relays designed for applications with emergency stop buttons and safety gates. Available with 24 VAC/DC, 110 VAC, and 230 VAC coil voltages, the Category 4-rated relays are equipped with internal positive temperature coefficient resistor short circuit and voltage-dependent resistor overvoltage protection. Designed with three normally-open positive guided safety contacts and one normally-closed monitoring contact, LG5925 relays provide a feedback circuit to monitor external contactors used for reinforcement of contacts, and feature monitored manual restart. Prices for LG5925 series safety relays start at $115.

The BH5928 Series relays are also designed for applications with emergency stops and safety gates. This dual-channel series provides one or two channels which can be monitored with the time delay function. Output configuration options include either three normally-open time delay positive guided safety contacts, or two instantaneous positive guided safety contacts and one normally-closed instantaneous monitoring contact. Three time delay options with potentiometer adjustment are available (depending on model) ranging from 0.1 to 30 seconds. The 24 VDC Category 4 relays are equipped with internal positive temperature coefficient resistor short circuit and voltage-dependent resistor overvoltage protection, and can be wired with or without cross-fail monitoring in the E-stop loop. Prices for the BH5928 series safety relays start at $198.

The BG5933 and BH5933 Series relays offer protection for applications with two-hand buttons or production machinery with dangerous closing movements. Available with 24 VAC/DC, 110 VAC, and 230 VAC coil voltages, the Category 4-rated relays are equipped with internal positive temperature coefficient resistor short circuit and voltage-dependent resistor overvoltage protection. These safety relays provide inputs for two pushbuttons, each with one normally-open and one normally-closed positive guided contact. Output configuration options include either two normally-open positive guided safety contacts and one normally-closed monitoring contact, or three normally-open positive guided safety contacts and one normally-closed monitoring contact. Prices for BG5933 and BH5933 series safety relays start at $139.

Category-4 rated light curtain controllers have also been added. Designed for light curtains with symmetric or asymmetric outputs, the LG5925 24 VDC light curtain controller features three normally-open positive guided safety contacts and one normally-closed monitoring contact and provides single or two-channel operation. The LG5925 light curtain controller is priced at $115. A multi-function features two normally-open positive guided safety contacts and one normally-closed monitoring contact; the controller can connect up to three light curtains, and offers protection, muting, and stepping modes. The multi-function light curtain controller is priced at $339.

The LG5929 extension module provides additional contacts for emergency-stop modules and safety gate monitors. Designed for one-channel or two-channel connection, the Category-4 rated extension module features five normally-open positive guided safety contacts and one normally-closed monitoring contact. The LG5929 extension module is priced at $95.

See the full line of Dold safety relay products at:
www.automationdirect.com/safety-relays

Safety is vital

and now everyone can afford more!

Don't let price stand in the way of making a machine or process as safe as possible

It could cost you a lot more in the long run. But you don't need to overpay to get reliable, high-performance safety devices that conform to all the latest standards. Our prices on safety relays, switches and light curtains mean you can do even more to protect what's important.

Safety relays protect people and machines.

- Single and dual channel safety relays for E-stop and safety gate applications
- Two-hand Control units for positive protection
- Light curtain controller modules are used in conjunction with light curtains for monitoring/control

Safety switches with key or hinge interlocks, limit switches and cable pull switches give precise, quick action.

- Visible operation
- Immunity to electromagnetic disturbances
- Electrically separated contacts with positive opening operation on N.C. contacts
- Actuation speeds of 0.5 m/s (max) to 0.01 m/s (minimum)
- IEC 947-5-1, EN 60947-5-1, UL 508, CSA C22.2 No 14 approvals

Safety light curtains in finger (14mm) or hand (30mm) protection resolutions

- Protective height: **14mm resolution - 142 to 1045mm**
  30mm resolution - 279 to 1827mm
- Operating distance: **14mm resolution - up to 3.5 mches**
  30mm resolution - up to 12 mches
- Double PNP outputs
- M12 quick-disconnect models (order cable separately)
- IP65 rated; Type 4 and Category 4 PL e

JUST A FEW PRICES ON SAFETY DEVICES

Product Description	AutomationDirect Price/Part Number
Safety light curtain with 30mm resolution - 24VDC, sender and receiver pair (sold separately) 0.25 to 12 meter operating distance, 279mm protective height, safety category 4	$250.00 YBB-30S4-0250-G012 (sender) $275.00 YBB-30R4-0250-G012 (receiver)
Safety limit switch, pull-reset action, plunger actuator, 30mm plastic body, 1/2 NPT	$12.75 AP2R11X11
Safety relay module, single channel, for E-stop circuits, 24 VDC, 2 N.O. contacts	$88.00 LG5924-02-61-24

AutomationDirect prices are U.S. published prices as of March 2011.
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Product Snapshots

Press Releases

AutomationDirect renews partnership with Kepware for communications

Kepware Technologies, the leader in Communications for Automation, has renewed its contract as AutomationDirect's communications supplier. AutomationDirect will deliver a single branded version of KEPServerEX called "KEPDirect OPC Server" for use with AutomationDirect controllers and remote I/O.

KEPDirect OPC Server connects your preferred Windows client software by providing a flexible and scalable communications and OPC server solution for connecting, managing, monitoring, and controlling AutomationDirect Ethernet remote I/O, DirectLOGIC PLCs, and Productivity3000 PACs. Communications is managed through a robust platform that supports an array of open standards, proprietary communication protocols, API's, and various automation system interfaces. KEPDirect OPC Server ($399) enables improved operations and decision making throughout all levels of an organization.

As a "Connected with Kepware" company, AutomationDirect will work with Kepware to ensure that the best communication support is developed for AutomationDirect products. "AutomationDirect has been an exceptional partner of Kepware for many years," said Tony Paine, President of Kepware Technologies. "We are not only extremely excited to renew our partnership, but also to expand on it by delivering additional connectivity to their new Productivity3000 PAC."

The companies will work together to support their joint customers through the partnership. Kepware will develop drivers for use on Windows™ desktop operating systems (Workstation and Server). The KEPDirect OPC Server will be available through AutomationDirect's website and their channel partners.

"The Kepware relationship is very important for us, as factory floor to boardroom data flow has become an integral part of manufacturing systems," said Jeff Payne, Product Manager for PLC, I/O, and PC Control of AutomationDirect. "The support for our Productivity3000 PAC is key for applications that can take advantage of its robust communications platform."

About Kepware Technologies

Kepware Technologies develops a wide range of communication and interoperability software solutions for the Automation industry. Our solutions allow you to connect disparate software and hardware systems, providing applications with quality, ease of use, and high performance. Furthermore, our in-depth experience with software design, development, support, and maintenance allows us to provide high-performance communications software without sacrificing quality and ease of use.

Learn more about KEPDirect OPC Server at:
www.automationdirect.com/kepdirect

Encapsulated transformers line expanded

The Hammond line of HPS Fortress commercial encapsulated single phase power transformers has been expanded to offer two new input voltage groups and to increase our existing voltage group up to 25kVA. The new voltage input groups include

277/240/208/120 VAC and 220/208/200/190x440/416/400/380 VAC. These new models allow for a broader range of input voltages and still maintain the 120x240 VAC output. All units are encapsulated with electrical grade silica sand and resin compounds to protect the core and coils, sealing out moisture and airborne contaminants and eliminating corrosion and deterioration. The NEMA 3R enclosures meet or exceed NEMA and ANSI standards for indoor and outdoor applications, and are UL and CSA listed as well as CE approved. The Fortress series encapsulated power transformers are backed with a 10-year limited warranty. Prices start at $77.

To see the full line of HPS Fortress commercial encapsulated power transformers, visit:
http://www.automationdirect.com/power-transformers

Inductive DC proximity sensors

The PEW series of stainless steel DC proximity sensors are flush-mountable shielded 8mm sensors with a 2mm sensing range. Available with either M8 or M12 quick disconnects, they are equipped with LED status indicators visible at wide angles, and have PNP outputs. PEW series inductive proximity sensors are priced at $45.

Also added are the LF40 series rectangular inductive DC proximity sensors. Two shielded and two unshielded models are available with 20mm or 35mm sensing ranges. The rectangular plastic

PNP sensors provide either normally-open or normally-open/normally-closed complementary outputs. LF40 series sensor prices start at $39.

To see the complete line of proximity sensors, visit : www.automationdirect.com/proximity

Compact fusible switches available

Gladiator™ compact fusible switches have been added to our line of circuit protection devices. The single-pole, two-pole and triple-pole AC devices are available in Class CC and Midget fuse models; single-phase DC devices are also available. The 35mm DIN rail mountable switches' compact size takes up only one-third the space of a molded circuit breaker and two-thirds the space of traditional fusible switches, saving space in control panels. The full

voltage rating of up to 600 VAC (80 VDC) allows installation flexibility in many applications where feeder and branch circuit protection are required.

Equipped with lockout/tagout capability and finger safe construction, Gladiator switches promote safe work-place practices by preventing contact with live components. Open fuse indication provides faster troubleshooting and reduced downtime.

Starting at $18, Class CC fuse models are UL98 listed and have a 200kA Short-Circuit Current Rating; Midget Class fuse models are UL 508 listed and have a 10kA Short-Circuit Current Rating. A 5A auxiliary contact with one normally-open and one normally-closed contact is also available for $9.

View the full line at: www.automationdirect.com/disconnect-switches

Current sensing line expands with ground fault sensors and DC current transducers and switches

The acuAMP® line of current sensors now includes AC ground fault sensors and DC current transducers and switches.

The GFS series of ground fault sensors monitors all current-carrying conductors in grounded single and three-phase delta or wye systems. Available in fixed-core models, the GFS series features jumper-selectable setpoints of 5, 10 or 30 mA. The sensors can accommodate up to 14 AWG copper wire and feature mechanical relay outputs with either manual or auto reset. The UL and CE approved GFS series of ground fault sensors start at $136.

The DCT series of DC current transducers combines a Hall Effect sensor and signal conditioner into a single package for use in DC current applications up to 400A. Designed to be compatible with most PLCs, data loggers and SCADA systems, the DCT series features jumper-selectable current input ranges and industry standard 4-20 mA or +/- 10 VDC outputs. Available in split-core or fixed-core models, DCT current transducer prices start at $117. DCS100 series DC current switches feature jumper-selectable current input ranges up to 100A and are available in normally-open solid-state and SPDT

relay output models. The switches are equipped with removable terminal blocks which accept up to 12 AWG solid or stranded wire. Prices for DCS100 DC current switches start at $90.

All acuAMP sensors are panel-mountable; convenient DIN rail adaptor accessories are also available.

The complete acuAMP series offers outstanding features, flexibility, and durability. Backed with a five-year warranty, the complete line of current transducers and switches provides dependable service for virtually any application.

See the full line of acuAMP current sensing products at: www.automationdirect.com/current-sensors

Photoelectric sensor line expanded

AutomationDirect's photoelectric sensor offering now includes 18mm rectangular plastic DC models. The IP67 rated sensors, available in 12 models, feature an 18mm diameter threaded lens and M12 quick-disconnect.

The GX3 series is a diffuse photoelectric available with either NPN or PNP light-on outputs and features background suppression technology with fixed sensing distances of 100 mm or 150 mm. GX3 series prices start at $49.

The GXP series is a polarized reflective photoelectric available with either PNP light-on output or NPN or PNP dark-on output and feature fixed sensing distances of up to 20 meters. GXP sensors include one round reflector. GXP series

Continued, p. 9>>

Get more power for your dollar

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Just about every electrical installation needs a transformer, so we carry high-quality Hammond Power Solutions products at great prices, in stock and ready for shipping the same day.

Control transformers
with lifetime warranty

HPS Imperator control transformers are specifically designed for high inrush applications requiring reliable output voltage stability. New models expand the input and output voltage ranges available, all at low direct prices!

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- **MLI** Control Series: 50VA to 500VA, 480x240 primary, 120x25 secondary
- **MQMJ** Control Series: 50 VA to 1.5kVA, 230x460 primary, 115x230 secondary
- **PG** Control Series: 50VA to 1kVA, 120x240 primary, 24x12 secondary

www.automationdirect.com/power

Encapsulated Transformers

The Fortress series of encapsulated transformers are single phase units, now available in 100VA up to 25kVA ratings.

The NEMA 3R enclosure makes them ideal for indoor and outdoor applications, such as schools, sports complexes, office buildings and lighting.

- 100VA to 25kVA sizes
- Input voltage ranges from 120 to 480 VAC
- Output voltages of 240 and 120 VAC
- NEMA 3R enclosure
- 10-year warranty

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Product Snapshots Cont.

Press Releases

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prices start at $39.

The GXR/E series are through-beam photoelectric models available with either NPN or PNP light-on or dark-on outputs and offer fixed sensing distances of up to four meters. GXR series receiver prices start at $35. GXE receiver-dependent emitters are available for $30.

65mm mushroom head metal pushbuttons now available

Fuji Command 30mm metal push-buttons with 65mm mushroom-style operators are momentary non-illuminated pushbuttons available in four colors and come with either a single normally-open contact block (red available as normally-closed) or with one normally-open and one normally-closed contact block.

Replacement contact blocks are available in single packs. UL listed and CSA certified, prices start at $19. See the Fuji Command 30mm pushbuttons at: www.automationdirect.com/pushbuttons

"A committee is a cul-de-sac down which ideas are lured and then quietly strangled."

– Sir Barnett Cocks (1907–1989)

"The government's view of the economy could be summed up in a few short phrases: If it moves, tax it. If it keeps moving, regulate it. And if it stops moving, subsidize it."

– Ronald Reagan (1911–2004)

"What's another word for Thesaurus?"

– Steven Wright

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- UL489 listing

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Feature Story

Trends in Automation

Upgrading Pump Stations with PLCs: When relays and timer circuits get old, they cause problems. Replacing them with PLCs keeps pumps running smoothly.

By Henry Palechek
Process Control Supervisor

One of the most important jobs of a water distribution system is to reliably deliver water to its customers. At our water district in California, we had pumping stations (*Figure 1*) with relay-based controls that were more than 30 years old, and the vintage of the controls caused a definite reliability issue.

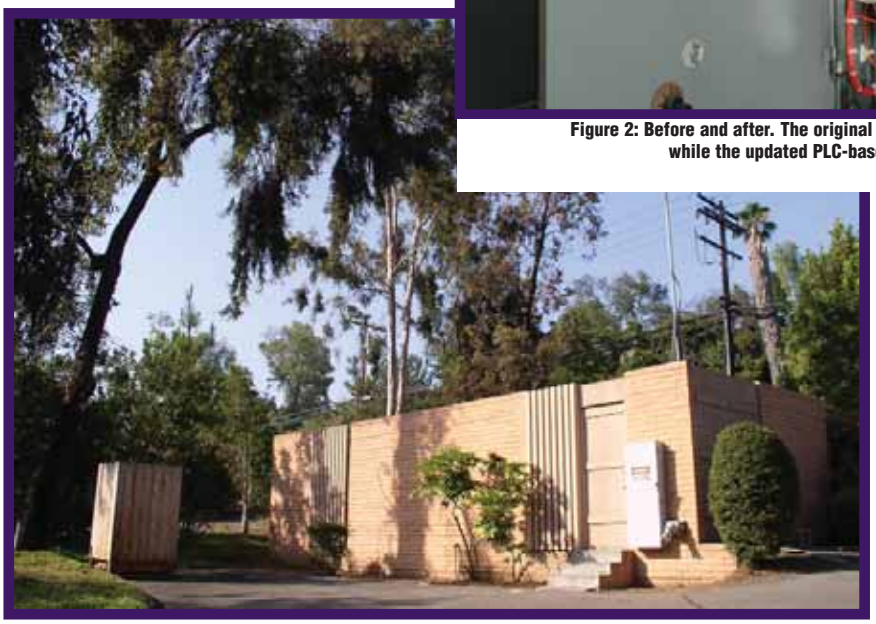

Figure 1: Typical pumping station in the water distribution system.

A typical pump station has three or four pumps, each powered by 100 or 125 horsepower motors. Because of the relatively large motor size, a part winding motor starting system is used with two motor starters. When the pump is turned on, the first motor starter is energized. Then, after a time delay, the second starter is energized.

Two types of timers were used in the control logic, pneumatic and electronic. As the pneumatic timers aged, they lost their timing repeatability. It was common to hear the motor strain while waiting for the second starter to pull in.

Figure 2, Before replacement

Figure 2: Before and after. The original relay-based system (above) was cluttered, while the updated PLC-based controls are much cleaner.

Electronic timers were sometimes even worse as their electrolytic capacitors failed over time. When the timers failed it was hard on the motor because it was running on only one starter until the overload tripped.

Personally, I've had to replace more of the electronic timing relays than any other device in the control circuit. I thought it was time to upgrade the pump controls and my company agreed, so we decided to investigate alternatives.

Taking a Test Drive

We decided to do a pilot test on two stations over a one-year period. We replaced all the pneumatic and electrical relays with DL05 PLCs from AutomationDirect (*Figure 2*). The PLCs were installed inside the motor control center (MCC) buckets by our in-house district electricians.

When the first pilot pump control circuit was changed over to PLC control, I set the delay time between the activation of the two motor starters to

0.5 seconds. Our control electrician didn't like the way the motor sounded, so with one quick edit I set the timer to 0.4 seconds. We've never had to readjust them since, and there's no longer any drift in the timing because the PLC is a digital device.

We were concerned about how well a PLC would hold up in the hot and electrically noisy environment of an MCC without cooling or a UPS, but they have proven to be very robust. The only failure we had was when a pump control valve's solenoid shorted out and pulled an excessive amount of current. Installing a fuse on the output solved the problem. It should be noted that this failure was our fault as we should have installed an output fuse in the first place.

We've since installed about 55 DL05 PLCs in our pumping stations, one on each motor, with no reliability issues in more than a decade of service.

Another advantage is the PLC simplifies and enhances pump operation. A typical MCC had hundreds of wires and dozens of relays (*Figure 3*) in multiple buckets. In some cases the wire numbers had fallen off over time, which made troubleshooting very difficult. In addition, the control logic only provided one alarm pump timeout. When a pump failed to start properly, we were never sure why it had failed.

Figure 3: The pile of parts left over when a PLC replaced relays in an MCC.

The specific problem was that when a pump failed to operate properly, it would time out and couldn't be restarted until manually reset by an operator. This reset cleared the timeout relay logic, making it hard for the technician to troubleshoot the problem.

Now, the PLC is programmed so the alarm can be reset by the operator; this allows the pump to run, while maintaining failure information in the ladder logic until the relevant area of the PLC program is reset by the technician. This gave us better flexibility in that a failed pump can be returned to service without losing information vital to the troubleshooting process.

Another enhancement was to expand the type of alarms sent back to the central SCADA system. Now, the alarm is defined three different ways: pump fail, MCC fail, or pump control valve fail. Before the upgrade, it was common to have a few pumps fail to start every week, but that's no longer the case.

Dealing with water hammer

In a water distribution system, another area of concern is always water hammer. Water hammer occurs when water flow is halted abruptly, causing a shock wave to travel through the line. The force of the shock wave can cause severe damage to critical control parts. When a large pump is started in our water pumping application, a pump control valve is used on the output of the pump to stop the possibility of a water hammer (*Figure 4*).

The motor is started into a closed pump control valve, and the valve is allowed to open slowly. On shutdown, the valve is closed slowly and a microswitch notifies the controller to turn off the motor.

Here's the sequence of events that occur when a large pump is started:

1. The first motor starter pulls in
2. The second motor starter pulls in
3. The pump control valve is commanded to open
4. The pump control valve is monitored to ensure it fully opens

Every step is timed, and if there's any failure of the proper sequence the motor is automatically turned off. The pump is then held out of service until an operator investigates the problem and pushes a reset button.

The old system was a nightmare to troubleshoot with its pneumatic and electrical relays. Now, with the PLC, finding the source of the problem is much easier.

The PLCs have allowed us to solve our control issues at a low cost with high

Continued, p. 13>>

Figure 4: A pump control valve prevents water hammer by opening and closing according to a careful timing sequence.

Feature Story Cont.

Trends in Automation

Continued from, p. 11

reliability. We still use the brick style *Direct*LOGIC DL05 PLC in existing MCCs, but in our new MCCs we've upgraded to the DL06 PLC, which has more expandability and a local LCD display option. We expect similar reliability from the DL06 PLCs, along with continued ease of use and superior vendor support.

About the Author

Henry Palechek is the information systems and process control supervisor at a water utility in California. He's been with the utility for over 16 years. He holds a Bachelor of Science in Information Systems, and has been teaching water technology courses at the local community college since the mid 90s. He also holds a California T3 Operator license.

"Arithmetic is being able to count up to twenty without taking off your shoes."

– Mickey Mouse (1928–)

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System Integrator Corner

UL 508A Certified Panel Shops

By Tim Roberts,
AutomationDirect

Several member integrators in AutomationDirect's SIDirect program have UL 508A certified panel shops. Although many installations and applications do not specify adherence to the UL 508A standard, it's good to be aware of the benefits of UL listing for your control panels.

The UL listing mark on an industrial control panel provides evidence of third party certification. It indicates that the panel complies with an accepted and specific safety standard. The listing mark may be applied to a wide variety of designs – from custom built to standardized designs with minor modifications.

While there is a confusing array of electrical safety standards to contend with, from the overarching national electrical code (NEC) to specific areas affecting control panels, such as NEC Article 409, the most commonly referenced standard for industrial automation applications is UL 508A. Briefly stated, UL 508A is the standard for Safety of Industrial Control Panels. The requirements specified in UL 508A are in turn based on UL 508, the standard for Safety of Industrial Control Equipment, the NEC, NFPA 70 and the standard for industrial machinery, NFPA 79. One important service a certified UL 508A panel shop offers is to apply these standards to customer applications and designs.

Out of the 38 system integration firms in the USA that are members of AutomationDirect's SIDirect Program, the following ten are UL 508A certified Panel Shops.

Please contact them to find out how they can meet your UL 508A panel requirements.

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MILWAUKIE, OR 97267
Contact: Bill Pascoe
Phone: 971-506-9338
Web site: www.YourAPS.com

HEYWOOD ENGINEERING, INC
RENO, NV 89511
Contact: Lance Heywood
Web site:
www.heywoodengineering.com

ICAD
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Contact: Cliff Taylor
Web site: www.icadautomation.com

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Raymond, ME 04071
Contact: Timothy Robey
Web site: www.robeycontrols.com

AI CONTROL SYSTEMS
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Contact: Sales
Web site: www.aicontrols.com

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Contact: Herb Burfield
Web site:
www.industrialautomation.us

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Web site: www.oneilelectric.net

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Contact: John Keller
Web Site: www.pca-inc.com

S&L AUTOMATION, INC
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Contract: Lori Pless
Web site: www.sandlautomation.com

ENER TECH ASSOCIATES, INC
Harrisburg, PA 17112
Contact: Sam Morello
Web site: www.eta-inc.com

"If there's anything unsettling to the stomach, it's watching actors on television talk about their personal lives."

– Marlon Brando (1924–2004)

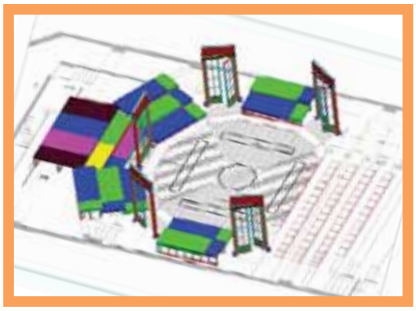
User Solutions

creative control solution

House Theatre of Chicago

By Ryan Poethke

House Theatre of Chicago's original-script production of The Nutcracker demanded moving, changing scenery that magically transformed the set at the push of a button. AutomationDirect's extensive line of pneumatic and electrical components helped us realize these design elements easily, elegantly, and reliably.



<u>The doors:</u>

The set design consisted of five sets of custom built French door units which were completely freestanding. These door units provided the "theatre-in-the-round" entrances for the actors. At the climax of the show, when young Clara's world is about to fall apart, scenic designer Collette Pollard envisioned the world physically cracking and beginning to come apart.

Using AutomationDirect's single-acting pneumatic cylinders, the "door toppers," situated above the doors, pivoted from one side, pushed up by the cylinder.

The cylinders were embedded in the vertical doorframe posts. The frames were constructed of 2" square steel box tube to provide a hollow space for the cylinders, and then cased in wood to provide the proper dimensions and appearance.

To prevent binding, the cylinder was topped with a plastic ball which allowed the end to slide as the cylinder extended. The air line ran down the frame and out to the control panel upstage.

<u>The tree:</u>

The closing scene of Nutcracker called for a small Christmas tree to magically grow from the stage on command. The design team wanted a

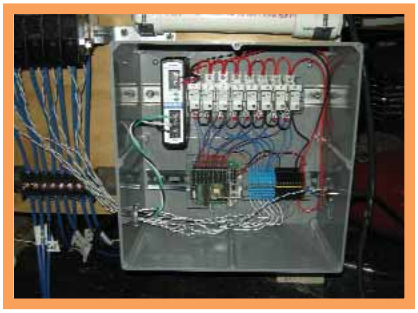
tree that grew from nothing to approximately 18 inches. The tree planter, filled with fake snow, had a false bottom which the tree punched through to magically appear when desired. Our "Charlie Brown Tree" was built from various diameters of polyethylene tubing wrapped with soft iron wire and covered with painted heatshrink tubing. The hinges at the base of the branches were simply short lengths of extension spring which allowed the tree to collapse into a piece of 1.5" PVC pipe.

The tree was pushed up through the floor by a 1" bore, 18" stroke double-acting cylinder. The double-acting feature allowed the stage crew to easily retract and reset the tree between performances.

The cylinder was able to push the tree around the 90-degree bend because the tree's "trunk" was also made of poly tubing; flexible yet rigid enough to withstand pushing by the cylinder.

There are three air lines attached to the under-stage tree mechanism; one each to extend and retract, as well as a purge line that was used to blow the

fake snow out of the tree storage tube before retraction. The purge line was added after we found that the fake plastic snow which fell into the tube prevented the tree from moving smoothly. It is important to note that the tree itself remained vertical and never "turned the corner." The horizontal portion contained only the travel of the cylinder and the poly tubing "pushrod."



The control panel:

The AutomationDirect three-way pneumatic valves were operated by an eight-way MIDI-to-relay card through single-pole interposing relays. MIDI control was chosen as it is a control protocol native to the audio world; since the effects had to fire in time with sound effects, it made sense to allow the audio playback computer to control the actuation of the valves.

It might be noticed that even though we have a double-acting cylinder for the tree, all eight valves are 3-way, and not necessarily suited to controlling a double-acting cylinder. We simply used two 3-way valves, one for each side of the cylinder, to minimize air loss around the seals of the cylinders. Because we could not run our compressor during the show due to noise, our air supply was limited. Use of the single-acting cylinders was limited to a rather short time, and the tree's cylinder did not need air once it was extended or

retracted. The purge line used to blow the fake snow out from around the tree was only used post-show, and thus we were able to run the compressor as needed for additional air.

A large white cylinder was mounted to the left of the panel to serve as a muffler; it silenced the sound of venting air as the cylinders were extended and retracted. It was built from 3" diameter PVC pipe and fuzzy paint rollers with their center tubes glued closed. This forced the air through the nap of the rollers and out through a grate on the bottom of the pipe.

Our use of AutomationDirect's extensive line of pneumatic and electric supplies and parts allowed House Theatre to tell the tale of The Nutcracker in ways that truly brought the audience into the story. Without support from AutomationDirect, House Theatre would not have been able to add this dimension of scenery movement and magic to our storytelling.

Tech Thread

temperature control

PLC-based system works where single loop temperature controllers fell short

By Tim Hanes,
AutomationDirect
Process Instrumentation Equipment
Product Engineer

In many applications, single loop temperature controllers are sufficient to provide control of heating and cooling. But in some applications, including the one detailed in this article, closely coordinated control among many temperature control loops is needed. In those cases and others, PLC-based temperature control can be the best solution.

A meltblown machine, a melted polymer extrusion machine used in manufacturing nonwoven materials, consists of four main components. An extrusion system provides a steady supply of molten polymer, and a heated spinbeam distributes the polymer into an even sheet or web. A heated process air system is used to attenuate or stretch the fibers, and a vacuum system removes the process air as the nonwoven web is formed.

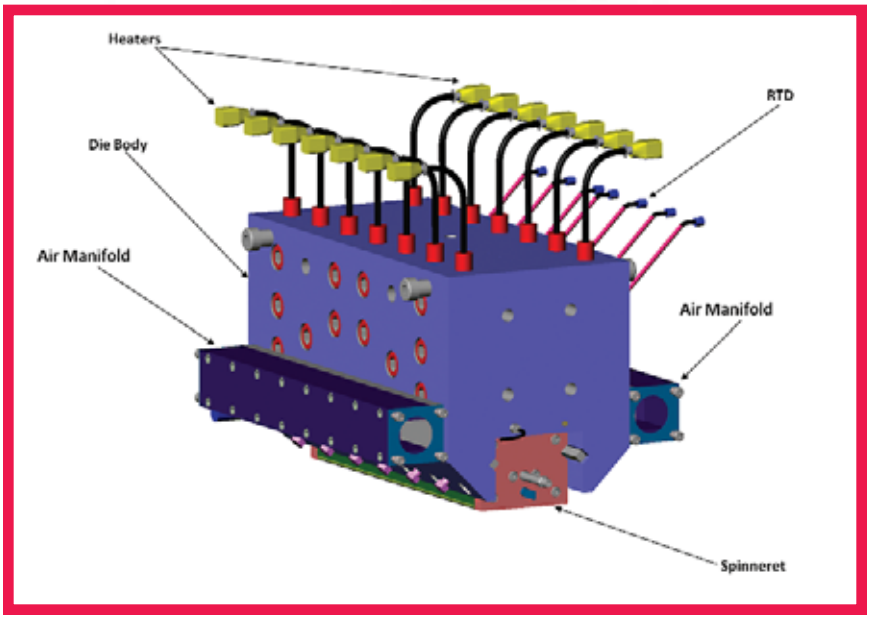


Figure 2, Example of Meltblown Die Assembly

The spinbeam consists of a large 304 stainless steel die body block weighing approximately 8 tons, and heated by 72 1.1 kW electric cartridge heaters. The heaters are paired into 36 zones spaced on 4" intervals down the length of the block.

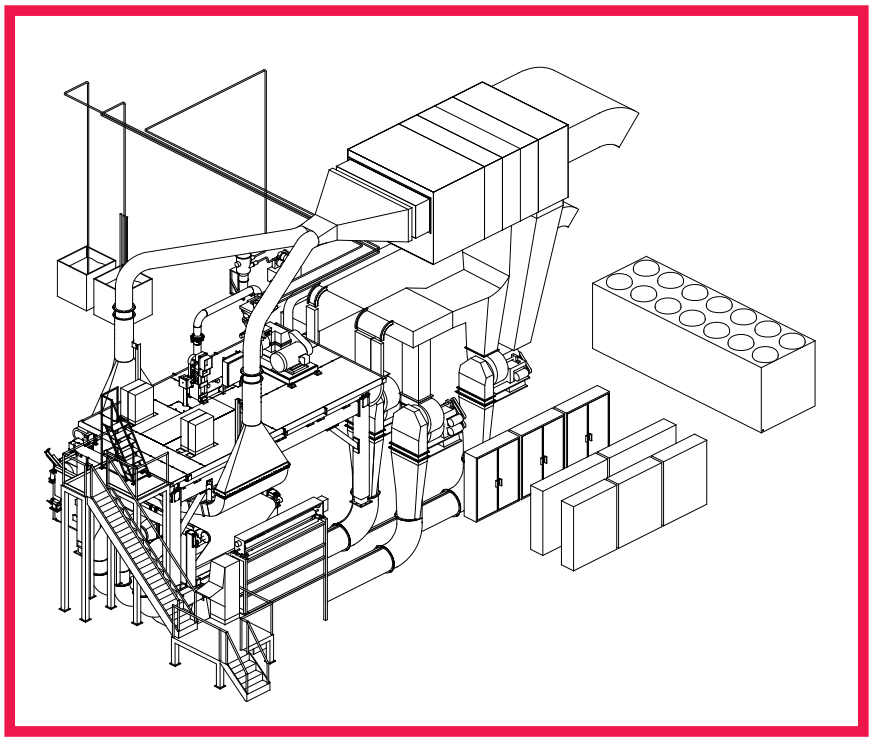


Figure 1, Machine diagram.

On this machine, each of the 36 zones had a PT100 RTD temperature sensor for feedback to that zone's single loop temperature controller. An output from each controller switched a pair of cartridge heaters to maintain an average block temperature around 425°F. Biasing setpoints for each of the 36 individual zone temperature controllers could be entered by the operators of the machine to adjust the temperature profile across the length of the spinbeam.

Process air heated by a 320 kW electric circulation heater is delivered by a low pressure blower through large air manifold assemblies. These assemblies are constructed of 0.75" thick 304 stainless steel plate attached to the die body using 28 12mm grade-8 bolts.

Varying Rates of Thermal Expansion

Thermal expansion of metal as it is heated is normally not a problem if all assembled parts expand at the same rate, or if clearances with tolerances down to the thousandths of an inch aren't required. But in this case, there were

Figure 3, Example HMI Screen

significantly different rates of thermal expansion for the die body and the air manifold. This was causing these two components to separate to the extent that the bolts connecting the assemblies were shearing.

When the meltblown machine was started, the solid die body was heated with the cartridge heaters at a rate of 2° per minute. The air manifold assemblies were heated only by the pre-heated process air, and were thus increasing in temperature at a rate of about 1° per minute. With the two different heating rates, it didn't take long to develop a significant temperature differential between the die body and the air manifold assemblies.

Because the solid stainless steel die body was more efficient at conducting heat than the hollow air manifolds, it could expand in length by as much as 1% (or 1.4 inches) before the air manifolds could expand. Something had to give, and in this case it was often one or more of the 28 bolts attaching the air manifold assemblies to the sides of the spinbeam.

The workaround solution was continuous intervention from the machine operators to monitor the die body and air manifold temperatures, and to adjust the temperature setpoints on the 36 individual controllers as required. A better solution was needed, one that replaced constant operator attention with automated control.

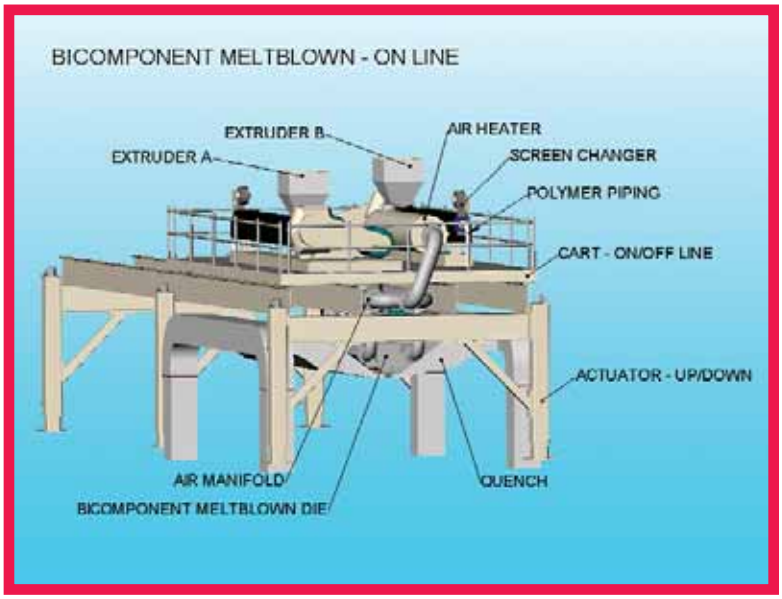


Figure 4, Example Bicomponent Meltblown Machine

The Power of the PLC

After analysis and process trials, it was determined that the system could handle a maximum temperature differential of about 50°F between the die body and the air manifolds without shearing the bolts.

One possible solution to maintain a maximum temperature differential was to install heaters and additional controls on the air manifold assemblies. However, due to their complex shape and space limitations, this solution was cost prohibitive.

A better solution was an improved automation system in the form of a PLC and a Human Machine Interface (HMI). Historically, PLCs were used for discrete control applications, but today's powerful PLCs have greatly expanded capabilities, particularly in the area of analog monitoring and closed loop control. These capabilities are provided in compact and low cost controllers featuring ease-of-use and a high degree of connectivity.

On the meltblown machine, the individual single loop controllers were eliminated and the 36 RTD zone temperature sensors were wired to individual analog inputs at the PLC. Also, temperature sensors were added to monitor the incoming temperature of the pre-heated process air entering the air manifolds.

Using the PLC's internal math functions, the 36 die body zone temperatures are averaged and compared to the incoming air temperature in the air manifolds. Based on the measured temperature differential, the PLC automatically

Continued, p. 21>>

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Tech Thread Cont.

temperature control

Continued from, p. 19

ramps the setpoints of the die body zones to individually control each zone's pair of cartridge heaters. Specifically, the PLC determines the correct setpoint for each of 36 PID control loops. Each loop reads an RTD input as the process variable, and uses the internally derived setpoint to modulate a control variable analog output to control the heaters.

This PLC-based control solution allows the machine to automatically heat at a rate that is compatible with the thermal expansion of the different components. The bolt shearing problem was solved, and the need for constant operator intervention was eliminated.

In addition, pre-programmed biased setpoint temperature profiles in the PLC can now be automatically used as required, eliminating the need for machine operators to enter separate biasing setpoints in the individual single loop controllers.

In addition to the improved control functionality, the PLC continuously provides and trends valuable data to the HMI, such as the process variable, the setpoint including any biasing, and the loop output control variable. Alarm points and conditions, either globally or for each loop, can also be viewed at the HMI. Touch screen HMI inputs allow changes depending on different conditions such as the polymer type.

Prior to the use of PLC-based control, constant operator intervention was required to provide safeguards against damage and to manually track various process conditions. By introducing PLC-based control, possible machine damage due to varying rates of thermal expansion has been eliminated, and valuable insight provided by tracking and trending data that wasn't readily available from the single loop controllers.

For complex temperature control applications with different heating or cooling profiles, PLC-based control offers a versatile, powerful and cost-effective solution. When paired with a touch screen HMI, additional process data can be viewed and analyzed, with adjustments to improve operations easily entered through the touch screen.

"Success is liking yourself, liking what you do, and liking how you do it."

– Maya Angelou (1928–)

"Instant gratification takes too long."

– Carrie Fisher (1956–)

"Money can't buy happiness, but neither can poverty."

– Leo Rosten (1908–1997)

Business Notes

Goings-on in the Industry

By Joan Welty,
Managing Editor

Kickstart and other new videos

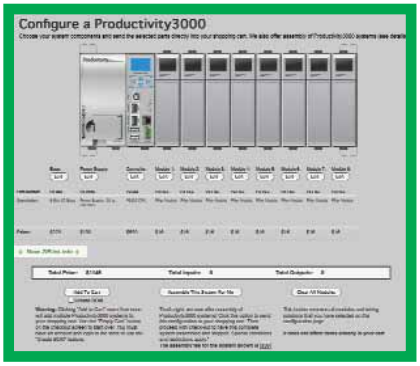
Have you seen the newest products launched by AutomationDirect? Now you can watch short videos with product descriptions, features and tips. Our new "KICKSTART" video program can be found on our Learn site and on our YouTube channel. Check out these short two-minute videos on products such as our new compact air cylinders, coiled air hoses, compact fuse switches and more.

Visit:
http://learn.automationdirect.com and look for the Kickstart tab along the top.

Or, go to:
www.youtube.com/automationdirect, where you can subscribe to our YouTube channel and leave comments on each video.

Other videos released recently include a four-part tutorial series where product manager Jeff Payne shows you how to use the many features of the Productivity3000 PAC programming software. Watch these under the Software tab on the Learn site.

Value Added Services



In keeping with our objective to provide the best value in industrial control products, AutomationDirect's new Value Add Services department provides customers with cost savings by packaging some of our high-quantity packaged products into smaller pre-defined quantities. Product areas where this has been done include fuses, supplementary protectors, DIN rail, and flexible cord.

Other services include some pre-assembly and customization. We can pre-assemble Productivity3000 controller racks with I/O modules based on your specifications. For a nominal charge, this service can save you time and effort, allowing you to complete projects or machine assembly more quickly. For more information on this assembly service, please visit the Productivity3000 Web site. (www.aboutplcs.com/p3000)

For OEMs, we offer a service to apply customer-supplied logo overlays to our products, which gives the equipment a custom look. We're continuing to find more ways to meet your specific needs. If there is something we could do for you, we welcome the opportunity to evaluate the idea.

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Our newest online Customer Forum category is where you can tell us what you think. The Give Us Your 2 Cents forum is the place to provide feedback and make requests on anything from Web seminar topics to Web store features to our company in general, you name it. You'll have opportunities to participate in brief surveys, provide application story ideas and answer occasional questions. Go to http://forum.automationdirect.com and look for the "Give Us Your 2 Cents" Forum.

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We have tried to make our product return process one of the easiest and least stressful you've experienced. As a matter of fact, we get "love letters" from customers telling us how pleasant it was to return a product to us! (We love to hear that, but we don't recommend doing it just for the experience.) But when you really do need to return a product that is under warranty, you can now obtain the Return Authorization

under your account via the Web. (All date codes and/or serial numbers must be supplied before the RA can be issued.) The process is this easy:

1. After you have logged in to your AutomationDirect account, visit our Returns page and choose the appropriate return reason.
2. You'll see a list of your orders which fall within the selected return window. Choose the order which contains the items you wish to return.
3. Verify your contact information, view the list of items from your order, and enter the quantities you need to return. Then "Submit" the return.
4. The Returns Team will look over your return request, and if everything checks out, the necessary paperwork and instructions will be sent to you immediately. (You can also obtain a 30-day money-back return authorization online.)

AutomationDirect sponsors VEX Robotics World Championships

AutomationDirect was pleased to sponsor the recent VEX Robotics World Championships at the ESPN Wide World of Sports Complex (within Disney World) near Orlando, Florida April 14-16. Over 500 teams comprised of 3500 high school, middle school, and collegiate students came together to celebrate their accomplishments and compete with (and against) the best of the best. These were the top robotics teams from over 200 VEX tournaments that took place around the world from May 2010 to March 2011.

Eleven teams from our local school system (Forsyth County, GA) qualified to attend, and one of those teams (from North Forsyth High) made it to the semifinal round! Congratulations to all the teams who made it to Orlando.

After a series of intense back-to-back matches and elimination rounds, the High School Champion alliance emerged with teams comprised of Massachusetts' Green Egg Robotics Club, Washington's W.A.S.A.B.I. 2 and Ontario, Canada's Simbotics teams.

The Middle School Champion represented an alliance of China teams from Sichuan Chengdu Longjiang Road Primary School and the Shanghai Luwan Teenagers Activity Center.

The College Championship title went to Massey University from New Zealand. In addition, one team from each of the three divisions was presented with an Excellence Award, the highest honor in the VEX Robotics Competition, given to the team with the most well-rounded VEX Robotics Program. Middle School, High School and College Excellence Award winners included, the VEXMEN: NightCrawler team from Downingtown Area Robotics in Downingtown, Pennsylvania, the Cheesy Poofs from Bellarmine College Prep in San Jose, California, and Massey University in New Zealand.

Learn more about VEX: http://www.vexrobotics.com

Tech Brief

variable frequency drives

Top 10 Tips: Specifying VFDs (Part one of a two-part series)

By Joe Kimbrell,
AutomationDirect
Drives, Motors, and Motion Control
Product Manager

Variable frequency drives — or VFDs — can reduce energy consumption, improve real-time control, and lengthen motor life; selecting the right one for your application requires asking the correct questions. Here are some expert tips to consider.

Determine if a VFD is right for your application.

The primary function of a variable frequency drive is to vary the speed of a three-phase ac induction motor. VFDs also provide nonemergency start and stop control, acceleration and deceleration, and overload protection. In addition, VFDs can reduce the amount of motor startup inrush current by accelerating the motor gradually. For these reasons, VFDs are suitable for conveyors, fans, and pumps that benefit from reduced and controlled motor operating speed.

A VFD converts incoming ac power to dc, which is inverted back into three-phase output power. Based on speed setpoints, the VFD directly varies the voltage and frequency of the inverted output power to control motor speed. There is one caveat: Converting ac power to a dc bus — and then back to a simulated ac sine wave — can use up to 4% of the power that would be directly supplied to a motor if a VFD were not used. For this reason, VFDs may not be cost-effective for motors run at full speed in normal operation. That said, if a motor must output variable speed part of the time, and full speed only sometimes, a bypass contactor used with a VFD can maximize efficiency.

Consider your reasons for choosing a VFD.

Typical reasons for considering VFDs include energy savings, controlled starting current, adjustable operating speed and torque, controlled stopping, and reverse operation. VFDs cut energy consumption, especially with centrifugal fan and pump loads. Halving fan speed with a VFD lowers the required horsepower by a factor of eight, as fan power is proportional to the cube of fan speed. Depending on motor size, the energy savings could pay for the cost of the VFD in less than two years.

Using VFDs to operate fans and pumps can significantly reduce energy consumption, because they can tailor fan speed to the application. Fan horsepower is proportional to the cube of fan speed, so depending on motor size, energy savings can compensate for the initial VFD purchase price in less than two years.

Starting an ac motor across the line requires starting current that can be more than eight times the full load amps (FLA) of the motor. Depending on motor size, this could place a significant drain on the power distribution system, and the resulting voltage dip could affect sensitive equipment. Using a VFD can eliminate the voltage sag associated with motor starting, and cut motor starting current to reduce utility demand charges.

Controlling starting current can also extend motor life because across-the-line inrush current shortens life expectancy of ac motors. Shortened life cycles are particularly prominent in applications that require frequent starting and stopping. VFDs substantially reduce starting current, which extends motor life, and minimizes the necessity of motor rewinds.

The ability to vary operating speed allows optimization of controlled processes. Many VFDs allow remote speed adjustment using a potentiometer, keypad, programmable logic controller (PLC), or a process loop controller. VFDs can also limit applied torque to protect machinery and the final product from damage.

Controlled stopping minimizes product breakage or loss, as well as equipment wear and tear. Because the output phases can be switched electronically, VFDs also eliminate the need for a reversing starter.

In addition to varying speeds, conveyor applications typically require frequent starting and stopping. Here, VFDs substantially reduce starting current to extend motor life.

Select the proper size for the load.

When specifying VFD size and power ratings, consider the operating profile of the load it will drive. Will the loading be constant or variable? Will there be frequent starts and stops, or will operation be continuous?

Consider both torque and peak current. Obtain the highest peak current under the worst operating conditions. Check the motor Full Loads Amps (FLA), which is located on the motor's nameplate. Note that if a motor has been rewound, its FLA may be higher than what's indicated on the nameplate.

Continued, p. 28>>

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AC, 208-230/460V, 3-phase, TEFC, 1800 rpm, 20 hp	$522.00 MTR-020-3BD18	$2,034.00 M2334T		$1,391.30 U20E2D
PMDC, 56C, 2 hp, 180V	$368.00 MTPM-002-1M18	$2,347.00 CDP3585	$1,261.00 4Z380 (not 56C)	$2,301.00 G644 (1.5 hp, not 56C)

All prices are U.S. published prices. AutomationDirect prices are from March 2011 Price List. Baldor prices taken from www.baldor.com 3/7/11. Dayton prices taken from www.grainger.com 2/22/11. Emerson prices taken from www.usmotors.com 2/22/11 or www.mscdirect.com 2/22/11. Prices and specifications may vary by dealer and configuration. Prices subject to change without notice.

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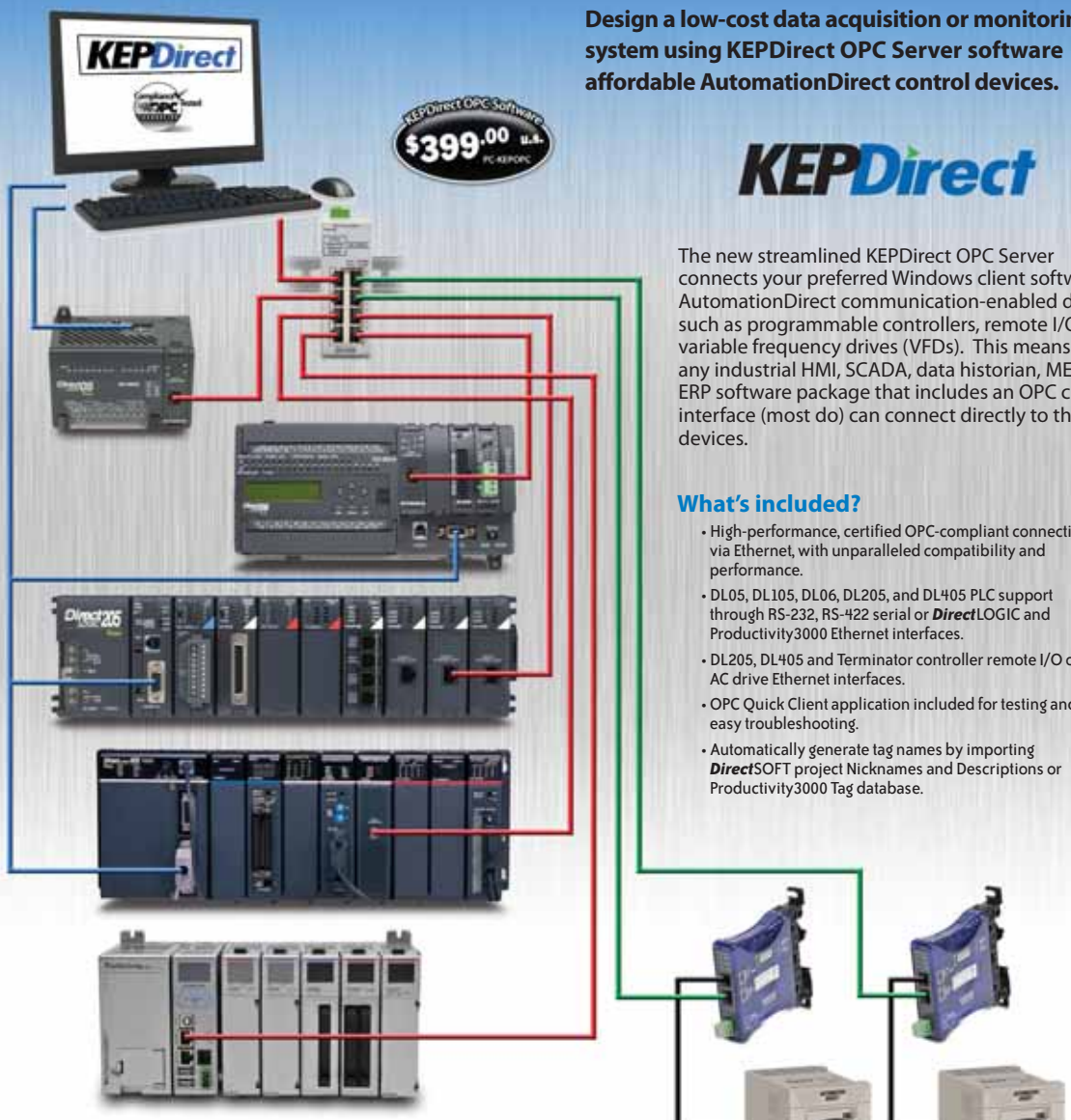

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Student Spotlight

The Future of Technology

Multi-mirror Solar Array

Pleasantville High School
Pleasantville, Iowa

Provided by Chip McDaniel,
AutomationDirect

The Industrial Technology students at Pleasantville High School, in Pleasantville, Iowa (southeast of Des Moines), have spent the last three years building a multi-mirror solar array. Students from four different technology classes have contributed to the project over the three year period; the AutoCAD and drafting classes have helped design and document the project, students in the metals class performed much of the welding and other fabrication tasks, while students in the electronics class have wired the machine and programmed the PLC. Instructor Frank Vanderpool has been the teacher and mentor who has championed the project from its inception.

Sunlight is focused on a solar heat exchanger positioned at the focal point of the array. Water is warmed inside the solar heat exchanger and then piped indoors to a storage tank and radiator in the nearby school shop where it is used to heat the room, before circulating back out to the solar heat exchanger to be reheated.

The array consists of 96 one-foot-square mirrors positioned in a 10x10 array. The four mirrors in the center of the array were omitted – because they would always be occluded from the sun by the solar exchanger. The array/exchanger assembly is hinged and fitted with wheels so that it can track the sun with both altitude and azimuth motions during each day. Two SureStep stepping systems from AutomationDirect are used to power these two axes of motion via custom gearboxes designed and built by the students.

Three simple photo-resistors are used as sunlight detectors to monitor the position of the sun. These photo-resistors are enclosed in narrow tubes, each with a slit facing skyward. The tubes are aimed ever so slightly away from the angle of the array - so that when sunlight reaches the bottom of the tubes and excites the photo-resistor, this light signals a need to move the array to keep alignment with the sun. One detector is used to monitor the azimuth axis, as the sun only moves in one direction across the sky each day, but two are required for the altitude axis, as the sun rises in the sky during the morning and then falls in the afternoon.

Figure 1

A *Direct*LOGIC DL06 PLC accepts discrete inputs from the sunlight detectors and uses that information to control the motion of the two stepper systems via H0-CTRIO modules. Additional logic in the PLC is used to approximately position the array on cloudy days so that if/when the clouds dissipate the array is positioned to begin its automatic operation. The PLC controls the flow of water through the solar heat exchanger, and also controls a pump inside the storage tank. Analog inputs to the PLC allow the monitoring of temperatures in four locations: at the solar exchanger, at the point where the water enters the building, inside the storage tank, and the temperature of the air inside the shop. Based on the various temperatures, the PLC opens and closes a valve to regulate the flow of water through the loop, and most importantly to stop the flow of water if the array is not producing heat for some reason (perhaps a cloud is blocking the sunlight). The PLC also controls the flow of water across a second heat exchanger inside the storage tank in order to maximize the heat transfer into the storage tank when possible.

Figure 2

On a sunny day the results can be more than impressive. In fact, on several occasions, the water has boiled and pressurized steam (measured at over 104°C) has caused problems such as blown hoses, requiring the team to reevaluate their design and method of operation. Other issues involved the inadvertent focusing of sunlight on a wooden component which actually caught on fire. Today, they have those issues resolved and water temperatures in the storage tank average about 165-180°F even on moderately sunny days. They routinely heat the shop exclusively with solar energy throughout the day and even for a few extra hours after the sun goes down due to the thermal energy stored in the tank.

Continued, p. 29>>

Tech Brief Cont.

variable frequency drives

Continued from, p. 24

Web printing presses, paper mills, and material converting applications require the precise speed regulation of closed-loop control. For such cases, VFDs can be run in a closed-loop control mode. Elsewhere, volts-per-Hertz (V/Hz) and sensorless (or open-loop vector) modes are used.

Don't size the VFD according to horsepower ratings. Instead, size the VFD to the motor at its maximum current requirements at peak torque demand. The VFD must satisfy the maximum demands placed on the motor.

Consider the possibility that VFD oversizing may be necessary. Some applications experience temporary overload conditions because of impact loading or starting requirements. Motor performance is based on the amount of current the VFD can produce. For example, a fully-loaded conveyor may require extra breakaway torque, and consequently increased power from the VFD.

Many VFDs are designed to operate at 150% overload for 60 seconds. An application that requires an overload greater than 150%, or for longer than 60 seconds, requires an oversized VFD. Altitude also influences VFD sizing, because VFDs are air-cooled. Air thins at high altitudes, which decreases its cooling properties. Most VFDs are designed to operate at 100% capacity up to an altitude of 1,000 meters; beyond that, the drive must be derated or oversized.

Be aware of braking requirements.

With moderate inertia loads, overvoltage during deceleration typically won't occur. For applications with high-inertia loads, the VFD automatically extends deceleration time. However, if a heavy load must be quickly decelerated, a dynamic braking resistor should be used.

When motors decelerate, they act as generators, and dynamic braking allows the VFD to produce additional braking or stopping torque. VFDs can typically produce between 15 and 20% braking torque without external components. When necessary, adding an external braking resistor increases the VFD's braking control torque — to quicken the deceleration of large inertia loads and frequent start-stop cycles.

Determine I/O requirements.

Most VFDs can integrate into control systems and processes. Motor speed can be manually set by adjusting a potentiometer or via the keypad incorporated onto some VFDs. In addition, virtually every VFD has some I/O, and higher-end VFDs have multiple I/Os and full-feature communications ports; these can be connected to controls to automate motor-speed commands.

Control mode comparison

	V/Hz	Sensorless vector	Closed loop
Operating complexity	Low	Moderate	High
Performance	Good	Good	High
Starting torque (typical)	150 to 175%	200%	200%
Speed regulation (typical)	±2%	±1%	±0.2%

Figure 4, VFD Control Modes

Most VFDs include several discrete inputs and outputs, and at least one analog input and one analog output. Discrete inputs interface the VFD with control devices such as pushbuttons, selector switches, and PLC discrete output modules. These signals are typically used for functions such as start/stop, forward/reverse, external fault, preset speed selection, fault reset, and PID enable/disable.

Discrete outputs can be transistor, relay, or frequency pulse. Typically, transistor outputs drive interfaces to PLCs, motion controllers, pilot lights, and auxiliary relays. Relay outputs usually drive ac devices and other equipment with its own ground point, as the relay contacts isolate the external equipment ground. The frequency output is typically used to send a speed reference signal to a PLC's analog input, or to another VFD running in follower mode.

Typically, general-purpose outputs of most VFDs are transistors. Sometimes one or more relay outputs are included for isolation of higher-current devices. Frequency pulse outputs are usually reserved for higher-end VFDs.

Analog inputs are used to interface the VFD with an external 0 to 10 VDC or 4 to 20 mA signals. These signals can represent a speed setpoint and/or closed loop control feedback. An analog output can be used as a feedforward to provide setpoints for other VFDs so other equipment will follow the master VFD's speed; otherwise, it can transmit speed, torque, or current signals back to a PLC or controller.

In Part Two, we will discuss selecting the proper control mode, understanding your control profile requirements, and more.

This article originally appeared in the February 2011 issue of MSD magazine and on:
http://motionsystemdesign.com/motors-drives/top-10-specifying-vfds-0211/?imw=Y

Student Spotlight Cont.

The Future of Technology

Continued from, p. 27

Future plans include switching the plumbing over to steam fittings to take advantage of the higher temperatures and pressures which have already been proven possible. Once they make that leap, they even envision the potential to run a small steam engine and produce electricity from the system. Frank Vanderpool is understandably proud of what his students have achieved this far. He reports, "The project has been, and continues to be, a wonderful learning experience for all of the students involved. The Multi-Mirror Solar Array has become a symbol of cooperative learning at Pleasantville High."

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Why use ZIPport connectors?

- **Eliminate repetitive wiring tasks**
- **Cut down installation time**
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Features

- **Complete connectors are built from components including bases, inserts, hoods, couplers and covers**
- **Available in 3A, 6B, 10B, 16B and 24B sizes**
- **Heavy-duty metal housings in polyester powder coated die-cast aluminum alloy, or self-extinguishing thermoplastic**
- **Single locking system (one lever locked on two pegs) or double locking system (two levers locked on four pegs)**
- **Operating temperatures from-40°C to 125°C (-40°F to 257°F)**
- **IP66 degree of protection with enclosure when coupled**
- **NEMA/UL Type 1, 4, 4X, 12 protection when housings are coupled**
- **Conforms with EN61984, VDE 0110, VDE 0627, EN 175301-801, and UL 1977, UL50, UL50E standards**
- **UL and CE approvals**

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The Break Room

Brainteasers & Humor

By Chip McDaniel

BrainTeasers

Shopping Cart Jumble

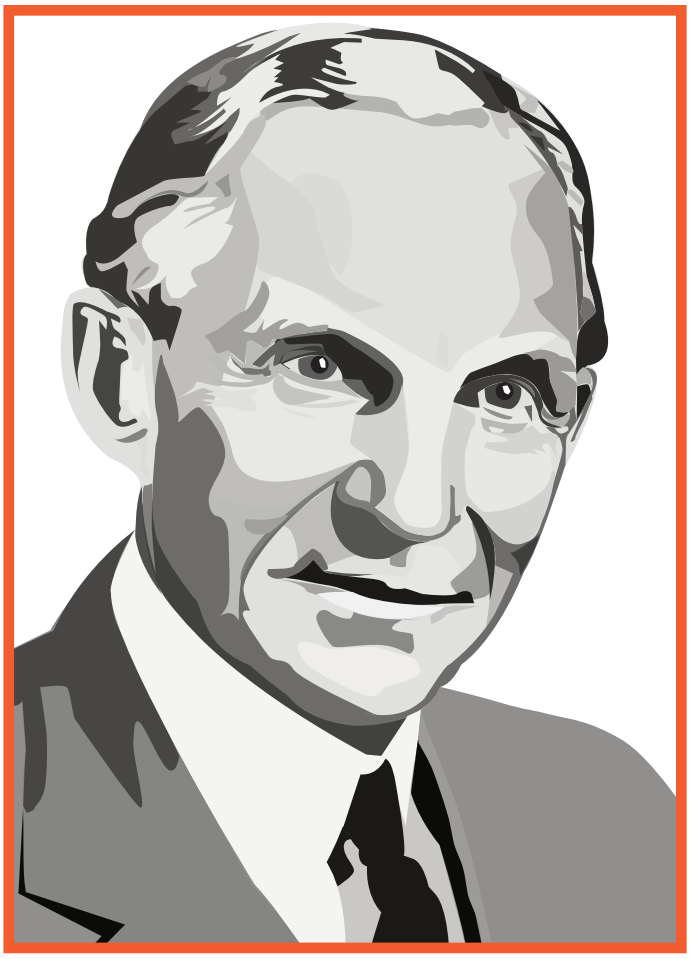
1.) An engineer went to: www.AutomationDirect.com to purchase some high-value automation parts. She purchased various quantities of three parts: proximity sensors at $50 each, Stable motor mounting bases at $10 each, and Nitra pneumatic fittings at $0.50 each. She purchased a total of 100 parts, and spent exactly $1000 dollars (qualifying her order for free 2-day shipping). *Can you calculate how many of each part she purchased?*

IO, IO, It's off to Work We Go

2.) A PLC system contains 36 I/O modules and a total of 100 I/O points. All the input modules are 4 point, and all the output modules are 2 point – except for one 6 point input and one 4 point output. *Can you discern the number of input vs. output modules in the system?*

Quarter Time

3.) The hopper of a packaging machine is filled with widgets on Monday morning. Each day the machine packages a single widget as a test sample, and then proceeds to package one quarter of the remaining widgets from the hopper. Recordkeeping is minimal, but it is noted that the number of widgets packaged on Monday and Wednesday is exactly 100 more than the number packaged on Tuesday and Thursday. *At the end of the day, Thursday, the production manager asks how many widgets remain in the hopper. Can you tell him?*



Henry Ford

Don't judge a driver by the car!

As told by a tour guide at the Edison & Ford Winter Estates Museum in Ft. Myers, FL. The tour guide prefaced the story by admitting that they couldn't verify it, so read it at your own risk!

It seems that Henry Ford was driving on a remote road one day and happened upon a stranded motorist with a broken-down car by the side of the road. As Mr. Ford was a very competent engineer and mechanic, he stopped to help. Without being recognized (or introducing himself) he rolled up his sleeves and spent more than a few minutes diagnosing and ultimately fixing the car's engine. Once he was finished, the impressed motorist thanked him, and tried to offer him some money for his time and effort. Mr. Ford had to decline the offered money several times saying, "No thank you, I have all the money in the world – it's simply not necessary." The motorist apparently got somewhat annoyed by that repeated phrase, and finally retorted "If you have all the money in the world, then why are you driving a Ford?"

If you are ever in the Ft. Myers, Florida area, be sure to visit the Edison & Ford Winter Estates. It's a fascinating museum for anyone interested in technology or history. Learn more at: www.edisonfordwinterestates.org

Please visit **www.automationnotebook.com** to find the answers to these puzzles.

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Economical

Effective, low-cost material level detection in a wide variety of applications, and a desirable alternative to electromechanical level switches. No expendable parts to buy and stock. No expensive, extra-cost options.

Maintenance-Free

Unlike paddle wheels, vibrating tines or other mechanical instruments, there are no components to jam, break or wear out. No need for routine maintenance, cleaning or replacing of worn parts.

Reliable Operation

Cote-Shield circuitry allows the Z-tron III to ignore coatings or build up on the sensing element. There are no false signals from dust or tunneling.

Easy-Installation

One-piece unit is easily installed through a single 3/4-inch vessel opening. Calibration is quick and simple.

Z-tron III™ Point Level Switch, a reliable low-cost, on/off level switch

The low-cost, Drexelbrook Z-tron III level switch is unaffected by sticky coatings and impervious to corrosive liquids. The all-electronic design means no moving parts to wear, break or fail. Based on field-proven RF technology, the Z-tron III is a simple and reliable on/off level switch.

The compact one-piece unit is inserted through a standard 3/4-inch NPT opening into the vessel so that the sensing element is positioned at the desired high or low level. (Other connection types and sizes are also available.) When the material level reaches a predetermined point on the sensing element, it causes a change in status at the electronic unit, resulting in actuation of the DPDT relay. The relay can be used to operate alarms, annunciators, valves, or other control or indication devices.

Drexelbrook's exclusive Cote-Shield™ circuitry enables the Z-tron III to ignore dust pileups, coatings, and sticky buildups on the sensing element.

Suspended dust particles are also no problem as the Z-tron III reacts only to actual high or low level conditions.

Point Level Measurement

Z-tron III™ Z02X-Series

Specifications

Power requirement
120 ± 25 Vac, 50/60 Hz (std.)
230 ± 25 Vac, 50/60 Hz (optional)
15-30 Vdc (optional)
(1 Watt maximum)

Output
DPDT relay

Contact Rating
Non-inductive 5A @ 120 Vac or
2A @ 230 Vac
Min. Rating 100mA/12VDC

Spark Tolerance
100 A (std)

Fail Safe
High (HLFS) or
Low (LLFS) field adjustable

Response Time
Approx. 0.2 sec.
Adjustable 0-60 seconds

Sensitivity
0.3 pF

Differential
Worst case with horizontal sensing element, 1/64"(.4mm) or less

Recommended Ambient Electronics Temperature
-40°F to 145°F*
(-40°C to 63°C)

*Unit will operate above 145°F but with reduced component life.

Temperature Effect
± 0.5 pF/50°F(10°C)

Line Voltage Effect
± 0.2 pF/20V

Sensing Element Connection
3/4" NPT (Optional Flange Mount)

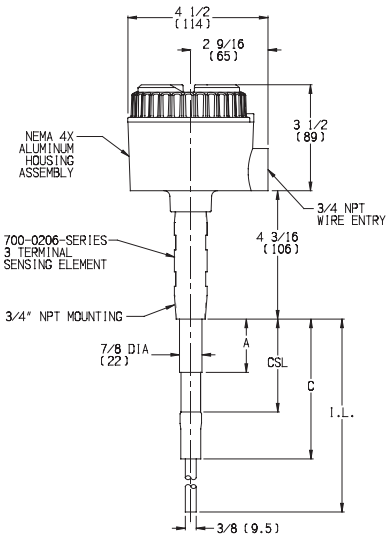
Sensing Element Wetted Parts
316SS & PEEK (2)

Process Pressure & Temperature
200 psi at 250° F
14 BAR at 121° C
Note: Temperature at electronics must not exceed 145° F.

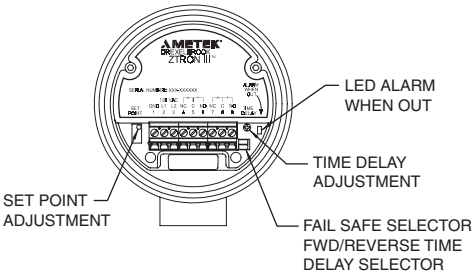
Approvals
UL/CUL/508 General Purpose
CE 0344

Housing
NEMA 1through 5 & 12

Dimensions



Wiring



NOTE: FAIL SAFE AND TIME DELAY SELECTED WITH DIP SWITCHES

POWER			RELAY CONNECTIONS					
1	2	3	4	5	6	7	8	9
GND	L1	L2	NC	C	NO	NC	C	NO

Model Number

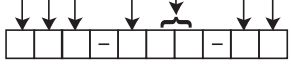
- **Technology**
  - **Z** RF Admittance
- **Reserved for future use**
  - **0**
- **Input**
  - **0** 120Vac
  - **1** 24Vdc
  - **3** 230Vac
- **Output**
  - **2** Double pole Double Throw Relay
- **Sensing Element**

	Application	Sensing Element	Pressure/Temperature	Wetted Parts
05	General Purpose	700-0206-201	14bar@121° C (200psi@250° F)	316SS & PEEK

- **Cote-Shield™ Length**
  - **1** 6 inch/152mm
  - **A** 10 inch/254mm
  - **B** 3.5 inch/88.9mm
  - **C** 2 inch/51mm

Note:
Cote-Shield should extend through Nozzle + Typical "Wall Buildup" + 2 Inches

- **Insertion Length (IL)**
  - **A** 6 inch/152mm
  - **B** 12 inch/305mm
  - **C** 18 inch/457mm
  - **D** 36 inch/914mm
  - **E** 48 inch/1219mm
  - **F** 60 inch/1524mm
  - **H** 72 inch/1829mm
  - **Z** Other



(1) Private label/OEM optimization available. Contact your Drexelbrook representative or factory for more detailed information.
(2) PEEK (Polyether-Ether-Ketone) is a special, high-temperature thermoplastic similar to TFE but with better abrasion resistance.

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The Do-more H2 series micromodular CPUs are "superchargers" for the time-tested DL205 hardware. We started with a blank slate and included many features our customers have been asking for. It's superfast, has lots of memory, embedded Ethernet - we know, we're pretty excited ourselves!

There are two CPU options:

H2-DM1 **$299.00** (1) USB port, (1) full-duplex serial port

H2-DM1E **$399.00** (1) USB port, (1) full-duplex serial port, (1) Ethernet port

- Over 1M bytes total memory (includes program, data and documentation)
- Program/monitor/debug over any embedded communication port.
- Supports up to 256 I/O locally and thousands more with optional Ethernet remote expansion racks.
- Supports inexpensive serial port expansion options for connection to bar code readers, ASCII devices, printers, etc.
- Four base sizes with built-in power supply support 12/24 VDC, 110/220 VAC and 125VDC (six and nine-slot only) power sources.
- Over 50 option modules are available, from discrete and analog to high-speed counter and Ethernet modules.

Note: Do-more CPUs are programmed with the new Do-more Designer software. DirectSOFT, and ladder programs developed with DirectSOFT, are not compatible with these CPUs.

Watch the Quick Start Video here: http://bit.ly/OdXm4Y

Get started fast with a Do-more Starter Kit - you get a prewired, 3-slot base with your choice of Do-more CPU, 8-point input simulator module, 8-point relay output module, Do-more Designer software on CD, a hard copy of the user manual, a USB programming cable, and a coupon for free online training. With the H2-DM1 CPU, the kit is $536.00; with the H2-DM1E, the kit is $626.00.

Compatible products include:

- C-more and C-more Micro HMI products
- Stride® Ethernet switches
- ZIPLink connector modules - relay, fuse and LED options
- Connectivity to SureServo® and SureStep® motion products
- Variable frequency drives and AC motors
- Discrete and process sensors

Discrete input/output modules

DC Input Modules

D2-08ND3	**$55.00**	8 pt. 12-24V sink/source
D2-16ND3-2	**$91.00**	16 pt. 24V sink/source
D2-32ND3-2	**$126.00**	32 pt. 5-15V sink/source
D2-32ND3	**$126.00**	32 pt. 24V sink/source

AC input modules

D2-08NA-1	**$77.00**	8 pt. 110VAC
D2-08NA-2	**$99.00**	8 pt. 220VAC
D2-16NA	**$135.00**	16 pt. 110VAC

DC output modules

D2-04TD1	**$68.00**	4 pt. 12-24V sink, 4A/pt
D2-08TD1	**$58.00**	8 pt. 12-24V sink
D2-08TD2	**$58.00**	8 pt. 12-24V source
D2-16TD1-2	**$99.00**	16 pt. 12-24V sink
D2-16TD2-2	**$99.00**	16 pt. 12-24V source
F2-16TD1P	**$119.00**	16 pt. 12-24 VDC sink
F2-16TD2P	**$99.00**	16 pt. 12-24 VDC source
D2-32TD1	**$129.00**	32 pt. 12-24V sink
D2-32TD2	**$129.00**	32 pt. 12-24V source

16-point module with removable terminal block

AC output modules

D2-08TA	**$110.00**	8 pt. 18-220VAC
F2-08TA	**$120.00**	8 pt. 20-125VAC, high current
D2-12TA	**$135.00**	12 pt. 18-110VAC

Relay output modules

D2-04TRS	**$69.00**	4 pt. 4A/pt. 8A/module
D2-08TR	**$69.00**	8 pt. 1A/pt. 4A/module
F2-08TR	**$77.00**	8 pt. form A, 10A/common
F2-08TRS	**$100.00**	8 pt. (5 form A, 3 form C, 7A/pt)
D2-12TR	**$110.00**	12 pt. form A, 1.5A/pt

Combination

D2-08CDR	**$66.00**	4 pt. DC in, 4 pt. relay out

Analog and Temperature modules

Wide range of low cost analog and thermocouple modules

Analog input modules

F2-04AD-1	**$201.00**	4-ch. 4-20mA
F2-04AD-2	**$221.00**	4-ch. 0-5V, 0-10V, -5 to +5V, -10 to +10V
F2-08AD-1	**$247.00**	8-ch. 4-20mA
F2-08AD-2	**$266.00**	8-ch. 0-5V, 0-10V, -5 to +5V, -10 to +10V

Analog output modules

F2-02DA-1	**$157.00**	2 ch. 4-20mA
F2-02DA-2	**$164.00**	2 ch. 0-5V, 0-10V, -5 to +5V, -10 to +10V
F2-02DA-1L	**$150.00**	2 ch. 4-20mA (12VDC supply)
F2-02DA-2L	**$156.00**	2 ch. 0-5V, 0-10V, -5 to +5V, -10 to +10V (uses 12VDC supply)
F2-02DAS-1	**$221.00**	2 ch. 4-20mA, 16-bit isolated
F2-02DAS-2	**$247.00**	2 ch. 0-5V, 0-10V 16-bit isolated
F2-08DA-1	**$301.00**	8 ch. 4-20mA, sink/source selectable
F2-08DA-2	**$271.00**	8 ch. 0-5V, 0-10V

Combination analog

F2-4AD2DA	**$281.00**	4-ch. in/2-ch. out 4-20mA
F2-8AD4DA-1	**$352.00**	8-ch. in/4-ch. out 4-20mA
F2-8AD4DA-2	**$352.00**	8-ch. in/4-ch. out 0-5V, 0-10V

Temperature

F2-04RTD	**$301.00**	4-ch. RTD input 0.1C resolution
F2-04THM	**$301.00**	4-ch. 16-bit thermocouple

Specialty modules

Input Simulator

F2-08SIM **$59.00** 8 pt Input Simiulator

Ethernet

H2-ECOM100 **$301.00** Master/Slave Ethernet 10/100 Mbps

Serial

H2-SERIO **$176.00** Three RS-232 ports

H2-SERIO-4 **$176.00** Two RS-232 ports & one RS-422/485 port

wow!

High Speed Counting & Motion Control

H2-CTRIO **$291.00** Four 100 kHz inputs, and two 25 kHz pulse train outputs

H2-CTRIO2 **$299.00** Four 250 kHz inputs, or two 20-250 kHz pulse train outputs

new!

Ethernet Remote I/O

H2-ERM **$201.00** Remote I/O 10 Base-T (Master)

H2-EBC100 **$301.00** Ethernet Base Controller (Slave)

Ethernet Remote I/O - Use an Ethernet Remote Master module (H2-ERM $201.00) in the local Do-more base and add up to 16 additional drops of rack-based I/O (with an H2-EBC100 in the CPU slot of each), or 16 Terminator I/O drops.

Four base sizes

3-slot base

D2-03B-1 110/220 VAC **$132.00**

D2-03BDC1-1 12/24 VDC **$150.00**

4-slot base

D2-04B-1 110/220 VAC **$143.00**

D2-04BDC1-1 12/24 VDC **$171.00**

6-slot base

D2-06B-1 110/220 VAC **$176.00**

D2-06BDC1-1 12/24 VDC **$194.00**

D2-06BDC2-1 125 VDC **$184.00**

9-slot base

D2-09B-1 110/220 VAC **$220.00**

D2-09BDC1-1 12/24 VDC **$238.00**

D2-09BDC2-1 125 VDC **$238.00**

Do-more with Extra Communications Ports!

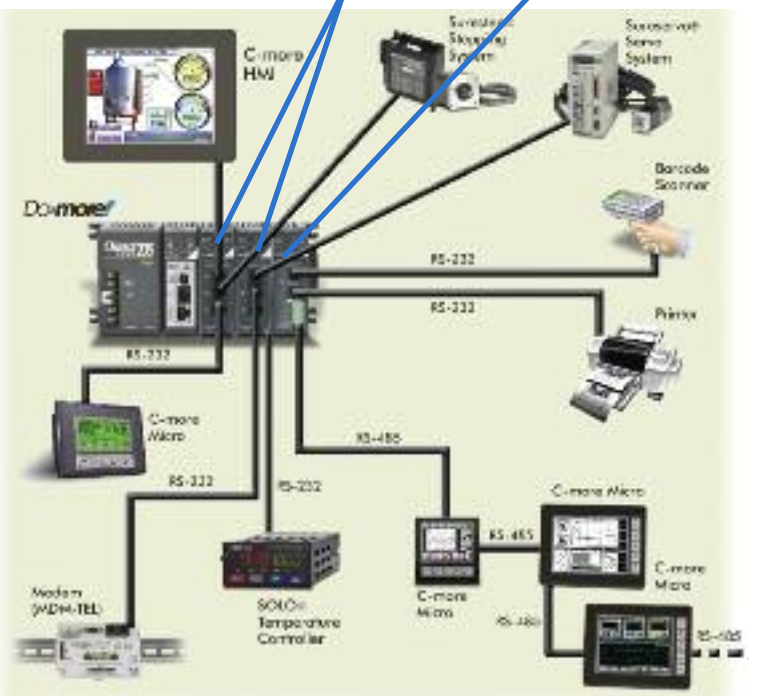
Both Do-more CPUs have one serial port built in...

Need more serial ports?

Then check out the two SERIO modules. Previously only available for our WinPLC product line, the serial port modules are a great addition to the Do-more PLC line-up, and allow connection of a wide range of serial devices, such as barcode scanners, scales, printers, modems, etc.

H2-SERIO-4 $176
Two RS-232 ports &
One RS-422/485

H2-SERIO $176
Three RS-232 ports



Add serial ports for less than $60 per port*!

Name your devices!

"Device abstraction" makes it easy to connect external devices - give then logical names and then refer to those names throughout your program code for ease and clarity.

Custom protocol instruction...

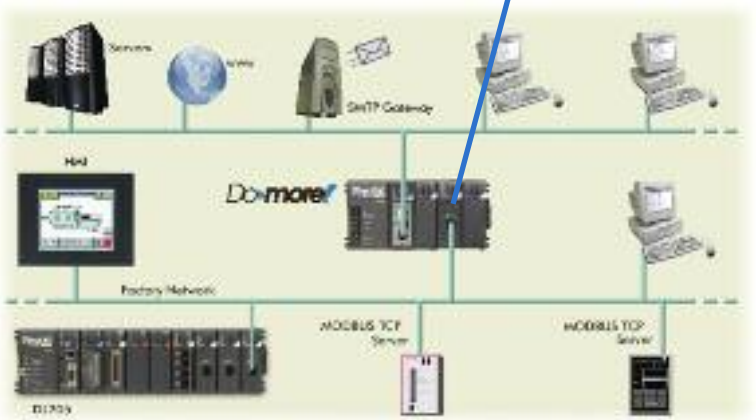
...makes it possible to "talk" to almost any device by letting you define any non-standard data exchange (serial or Ethernet)!

** $176 for 3-port serial comm module*

Download the free Do-more Designer Software today and take a look at these great features and so much more

Watch the Video about this topic:
http://bit.ly/PMd0t3

H2-ECOM100 $301



Improved to Do-more! NEW

Now all your serial port setup is done through the Do-More Designer Software, and if you should need to replace a serial module, all of its parameters and setup are stored in the CPU and are automatically loaded and ready to go when the system powers up.

Need more Ethernet?

The first Ethernet port is a real bargain - it's built into the Do-more CPU (H2-DM1E) for just $100 more than the non-Ethernet version (H2-DM1). But many applications require a second Ethernet port. Add an H2-ECOM100 and connect your Do-more to segregated networks for security or isolation.

Do-more with High-speed I/O!

High-speed operations

The CTRIO and CTRIO2 modules are capable of a wide variety of high-speed input and output operations. Many of these operations take place on board the module, and are independent of the scan time of your PLC. With flexible 4-channel input and separate output channel design, these modules can satisfy high-speed counting, timing, and pulse catch operations, along with high-speed discrete output or several profile choices of pulse output operations. Not all combinations of input functions and output functions are possible within the resources of the module, but these examples are typical of the applications for these modules.

$291

Fast

Counting & timing up to 100 kHz:

H2-CTRIO $291.00

Four 100 kHz inputs, and two 20-25 kHz pulse train outputs

NEW $299

Faster

Counting & timing up to 250 kHz:

H2-CTRIO2 $299.00

Four 250 kHz inputs, and two 20-250 kHz pulse train outputs

Inputs Supported:

- Counter
- Quad Counter
- Pulse Catch
- Edge Timer
- Dual Edge Timer

Outputs Supported:

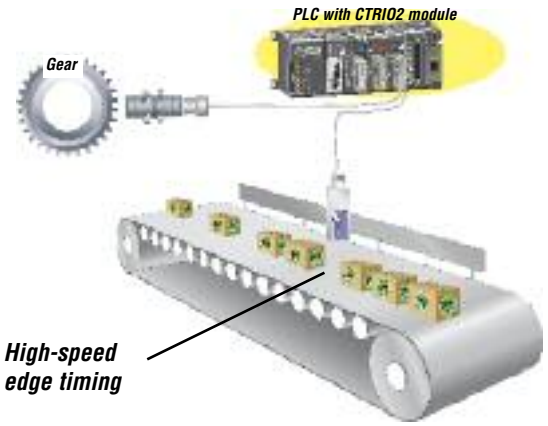
- Pulse train - used for servo/stepper motor control. Configurable for CW/CCW or step and direction.
- Discrete outputs - assigned to Counter/Timer input functions
- Raw output - outputs controlled directly from the CPU interface program
- Programmable limit switch (H2-CTRIO2 only)

Improved to Do-more! NEW

Now all your CTRIO and CTRIO2 configuration is done through the Do-More Designer Software - no more separate software "workbench". And if you should need to replace a high-speed module, all the setup parameters and profiles are stored in the CPU and are automatically loaded and ready to go when the system powers up.

High-speed timing

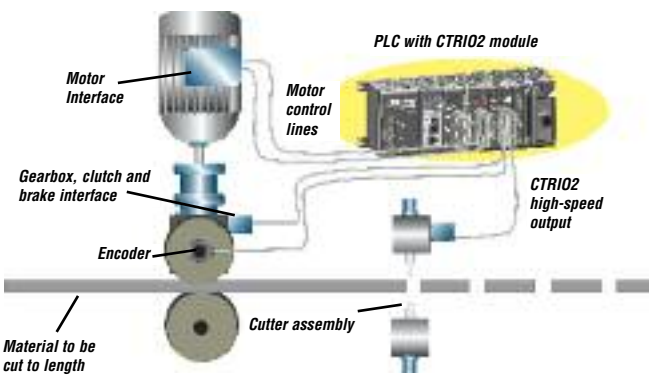
The CTRIO and CTRIO2 modules can be configured for timing functions based on both count or rate. Using a common configuration of a proximity switch sensing the teeth on a gear, the module is able to calculate the velocity of the gear based on the rate at which it receives counts. This value can be scaled within the module to the engineering units required for the application.



High-speed counting

The CTRIO and CTRIO2 modules can be configured for counting functions via the use of an encoder input. Up to two quadrature encoders per CTRIO or CTRIO2 module are available with connections for external reset, capture and inhibit signals. In a simple cut-to-length application as shown below, the encoder provides an input position reference for the material to the module. The module's high-speed outputs are wired to the cutting device and to the clutch and/or braking device. When the count from the encoder is equal to a pre-programmed setpoint within the module, the high-speed outputs are activated to stop and cut the material to a repeatable fixed length. Additionally, the clutch/brake signal can be used as an inhibit signal so counts are not accumulated while the material is being cut.

High-speed cut-to-length application



Do-more with Precise Motion Control!

Here's why

There are many applications that require accurate motion control, whether it's precision position control or tight speed regulation. The Do-more PLC, using the high speed pulse output mode on the H2-CTRIO2 module, offers a superior control solution for closed-loop motion control using SureServo servo systems, or super-low-cost open-loop control with SureStep stepping systems.

Here's how

When coupled with our *Sure*Servo or *Sure*Step motion products, the resulting system is extremely cost-effective.

A Do-more-based motion control system is very well-suited to applications such as:

- cut-to-length
- indexing tables or conveyors
- and many more...

AutomationDirect Do-more PLC with H2-CTRIO2 modules ($299.00) using pulse output feature

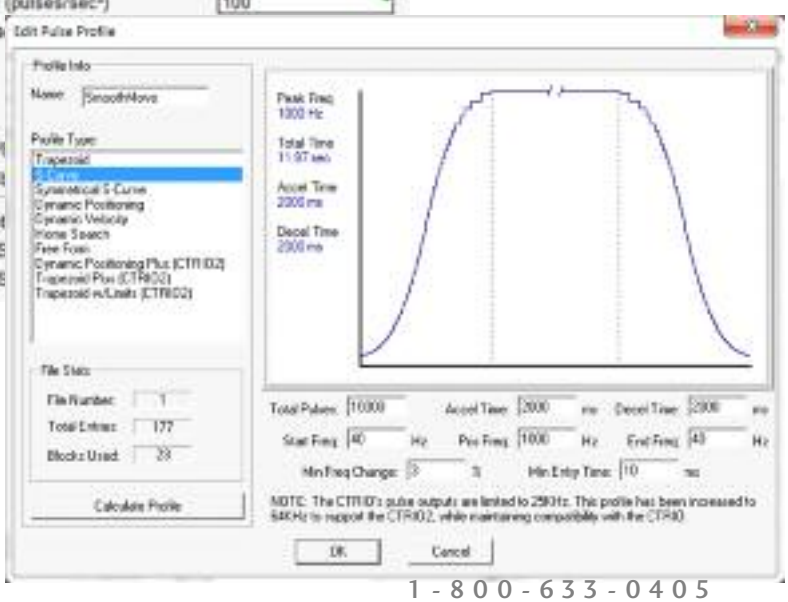
Pulse output from H2-CTRIO or H2-CTRIO2 module

Familiar with H2-CTRIO?

If you've used our H2-CTRIO module in the past, take a look at the new H2-CTRIO2. When coupled with a Do-more CPU, you get:

- Faster pulse output frequency (20-250 kHz)
- All configuration and motion profiles are created in the *Do-more Designer* Software and are stored in the CPU.
- The new "Axis Mode" instructions make the code for your motion application a cinch

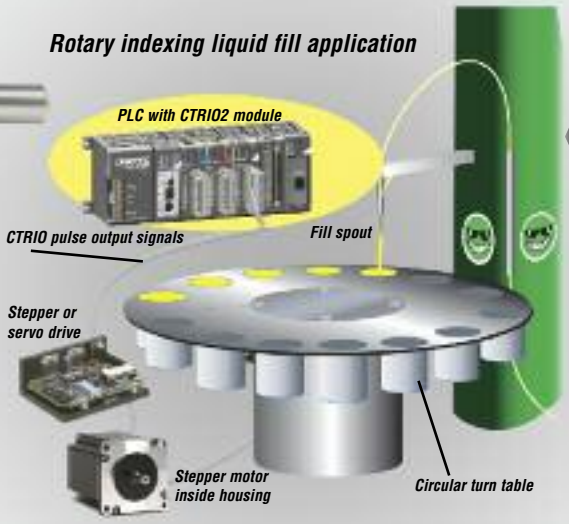
Download the free software today and see for yourself.



**** Note: The Do-more PLC is compatible with the legacy H2-CTRIO module and you will benefit from having the configuration and profiles created in the Do-more Designer Software and stored on the CPU. This alone is a big improvement over the previous functionality.***

www.sureservo.com

Rotary indexing liquid fill application



The *Sure*Servo family of brushless servo systems from AUTOMATIONDIRECT is fully digital and offers a rich set of features at dynamite prices. Choose from **eight standard servo motors** that can be **used in combination with one of three standard servo drives**.

These servos are designed for flexibility and quick implementation. *Sure*Servo drives accept a wide range of command sources:

- Built-in motion controller with preset position, velocity or torque
- Select presets with switch inputs and/or the multi-drop Modbus serial interface
- Position commands with "pulse and direction"or CW/CCW format
- Encoder follower
- Analog voltage Velocity or Torque command
- Eight standard systems from 100W to 3kW
- Use with ***Direct***LOGIC PLCs or any other host control
- Drives feature on-board indexer and adaptive tuning modes
- Free set-up software
- 2 year warranty

Sureservo®

(see section 16 of catalog)

For configuration, tuning and diagnostics, use the drive's integrated keypad/display or take advantage of the free *Sure*Servo Pro™ PC-based software. Tune the system easily with adaptive auto-tuning selections or manual mode. Adapt to diverse applications with configurable I/O,including 8 digital inputs, 5 digital outputs, 2 analog monitors and a scalable encoder output.

Surestep®

Ease of use out of the box!

(see section 16 of catalog)

The *Sure*Step stepping family has four standard motors to handle a wide range of automation applications such as woodworking, assembly, and test machines. Our square frame or high torque style stepping motors are the latest technology, resulting in the best torque to volume. We have **NEMA 17, 23, and 34 mounting flanges and holding torque ranges from 83 oz-in to 434 oz-in.** A 20-foot extension cable with locking connector is a standard accessory to interface any of the four stepping motors to the microstepping drive, and can be easily cut to length if desired.

Do-more with Remote I/O!

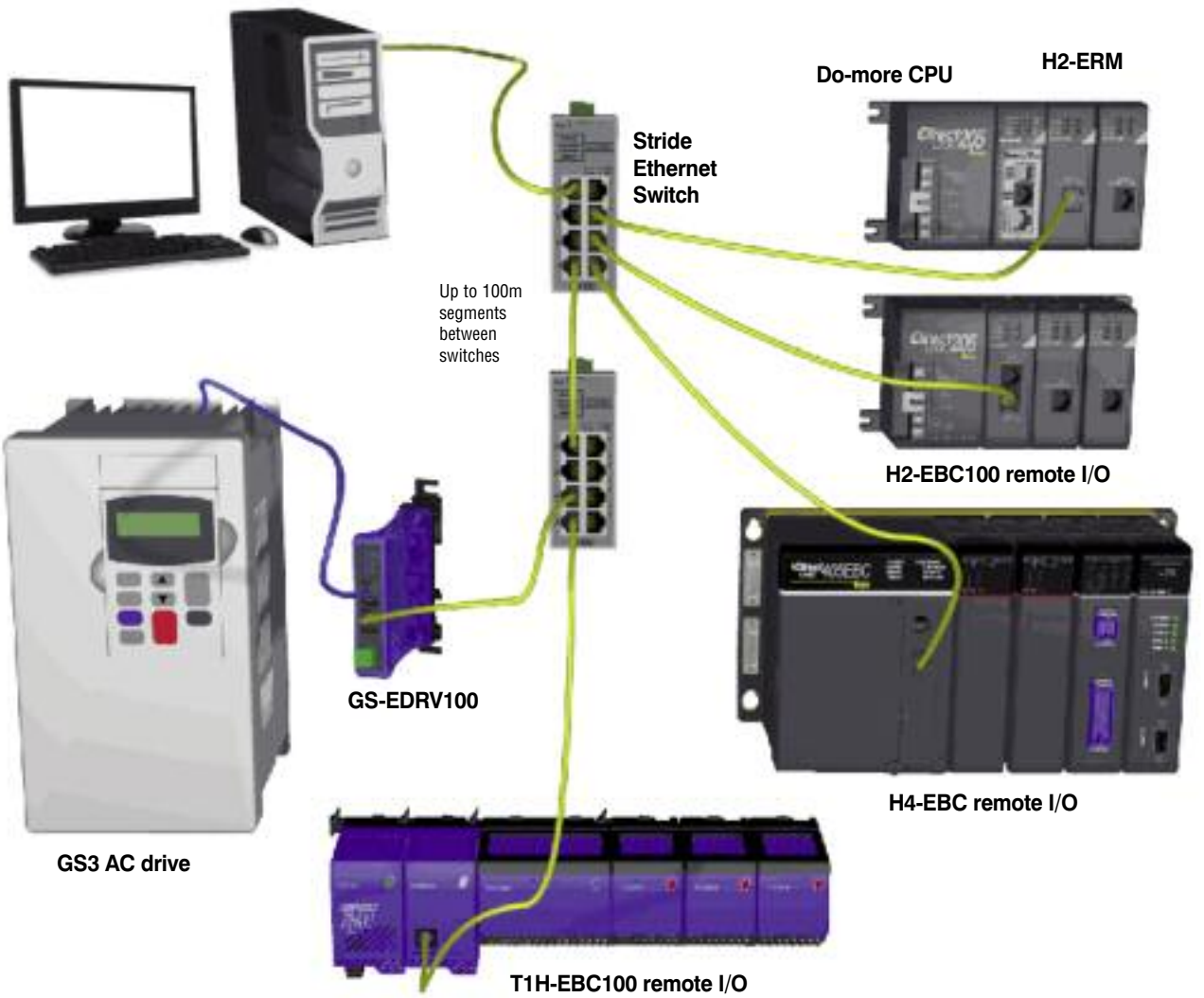
Expand your I/O

Your local Do-more base can support 8 slots with as many as 32 I/O points in each. If you need more, you can install an H2-ERM Remote I/O Master module in your local rack and connect up to 16 remote I/O drops to expand your system. Each of those 16 drops can provide hundreds more I/O points. Need more? Add another H2-ERM, and connect 16 more. The Do-more CPUs can easily support thousands of I/O points in a single system.

Locate I/O anywhere

DL205 (and DL405) remote I/O bases can each be located up to 100 meters from the local base (or between Ethernet switches) using EBC100 slave modules in the CPU slot. And you have the flexibility of using Terminator rackless field I/O drops as well.

To configure the ERM Master module and its slaves, use a PC running the ERM Workbench tool (included with Do-more Designer software). The PC may be removed once the system is configured.



Kickstart your experience with the Do-More Starter Kit!

Get started fast!

Choose the Do-more starter kit to get going fast. You get a prewired, 3-slot base with your choice of Do-more CPU, an 8-point input simulator module, and an 8-point relay output module.

Also included are a copy of the Do-more Designer software on CD, a hard copy of the user manual, a USB programming cable, and a coupon for free online training.

Free online training!

Both kits include a coupon for a 30-day free trial of online training from Interconnecting Automation (the official training partner of AutomationDirect). You'll get full, unlimited access to all the training videos free for 30 days.

Includes everything!

This is everything you need to evaluate the product and see for yourself what a powerful and easy-to-use controller Do-more can be!

With USB and Seial Port — Only $536

With On-board Ethernet included — Only $626

Watch the Video about this topic: http://bit.ly/PzALIp

H2-DM1-START - $536.00

This Do-more H2 series PLC starter kit includes:

H2-DM1	CPU with RS-232 and USB ports
D2-03B-1	Three-slot base (pre wired)
F2-08SIM	Input simulator
D2-08TR	Output module
USB-CBL-AB6	USB programming cable
H2-DM-M	Do-more User Manual
DM-PGMSW	Do-more Designer Software CD-ROM

And the coupon for 30 days of FREE Training

H2-DM1E-START - $626.00

This Do-more H2 series PLC starter kit includes:

H2-DM1E	CPU with RS-232, USB and Ethernet Port Built-in
D2-03B-1	Three-slot base (pre wired)
F2-08SIM	Input simulator
D2-08TR	Output module
USB-CBL-AB6	USB programming cable
H2-DM-M	Do-more User Manual
DM-PGMSW	Do-more Designer Software CD-ROM

And the coupon for 30 days of FREE Training

NOTE: No substitution of individual part numbers.

Continue Reading about the Do-more Designer Software...

Do-more Designer: FREE Software that actually *does more!*

Download the free software today and check out all these great features!

The Do-more Designer Software is a free download at www.do-more.com

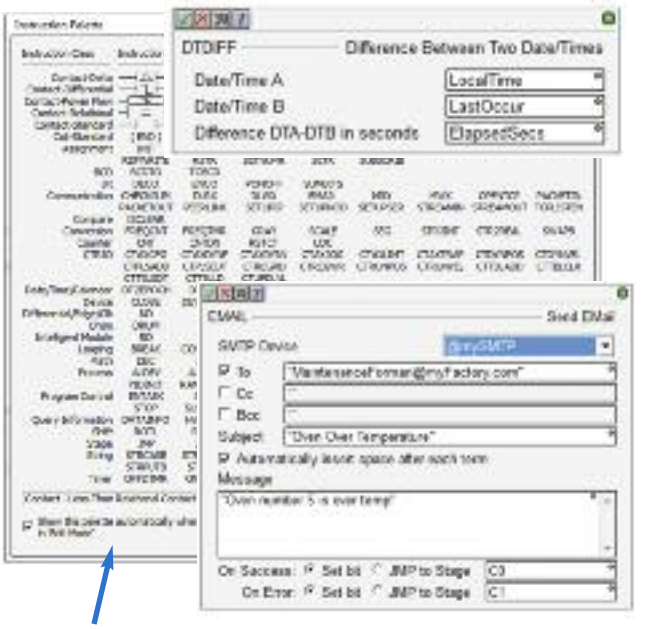
To test your program, use the built-in simulator or connect to a Do-more PLC with your choice of a serial, USB or Ethernet connection.

Built-in simulator

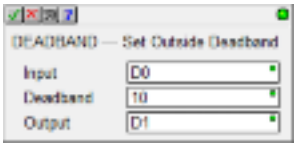
The built-in simulator creates a virtual PLC so you can test your logic without a PLC present.

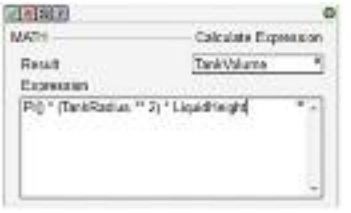
Watch the Video about this topic: http://bit.ly/T3GnRj

- Windows application uses the same code as the CPU firmware - for the most accurate simulation.
- Simulates discrete and analog I/O with access to timers, counters, control bits, etc.
- Simulate PID - Use the Simulator coupled with the Trend View for outstanding visibility into your PID processes.



Use the pop-up instruction "Palette" to quickly select an instruction and insert it into your ladder!





Optimized instruction set

The Do-More instruction set was developed by listening to our customers' needs and requests, with flexibility and ease-of-use as our goals. **Download the free software today** and take a look at these powerful and easy-to-use instructions.

Watch the Video about this topic: http://bit.ly/PCgppY

Local I/O is automatically configured

Connect to your PLC, and visit the I/O Configuration window for full Auto-Discovery of your modules in the local base.

Powerful, intuitive math

The Spreadsheet style MATH instruction allows mixing of data types* and it accepts formulas and variables. The MATH instruction also allows nesting with parentheses to 8 levels, plus:

- Ten 'Real' Functions, including Natural Log, Log, e, PI, Square Root, and conversions.
- All the standard Trig Functions
- Eight Statistical Functions, including Average, Min & Max, RANDINT and RANDREAL (to generate random values), Standard Deviation functions and more.
- Thirteen Conditional functions, including six CountIF, six SumIF, and If/Else expressions with a full complement of binary operators.

If that's not enough, how about Absolute Value, Time, Memory, and Indirect addressing? You even get access to system-level bits such as $IndexError, $OutOfRange, $Overflow, etc.

**** Note about data types: integer and real types are really all you need but Do-more does include a few BCD and octal conversion instructions for legacy data types.***

High-speed I/O and motion control: simplified

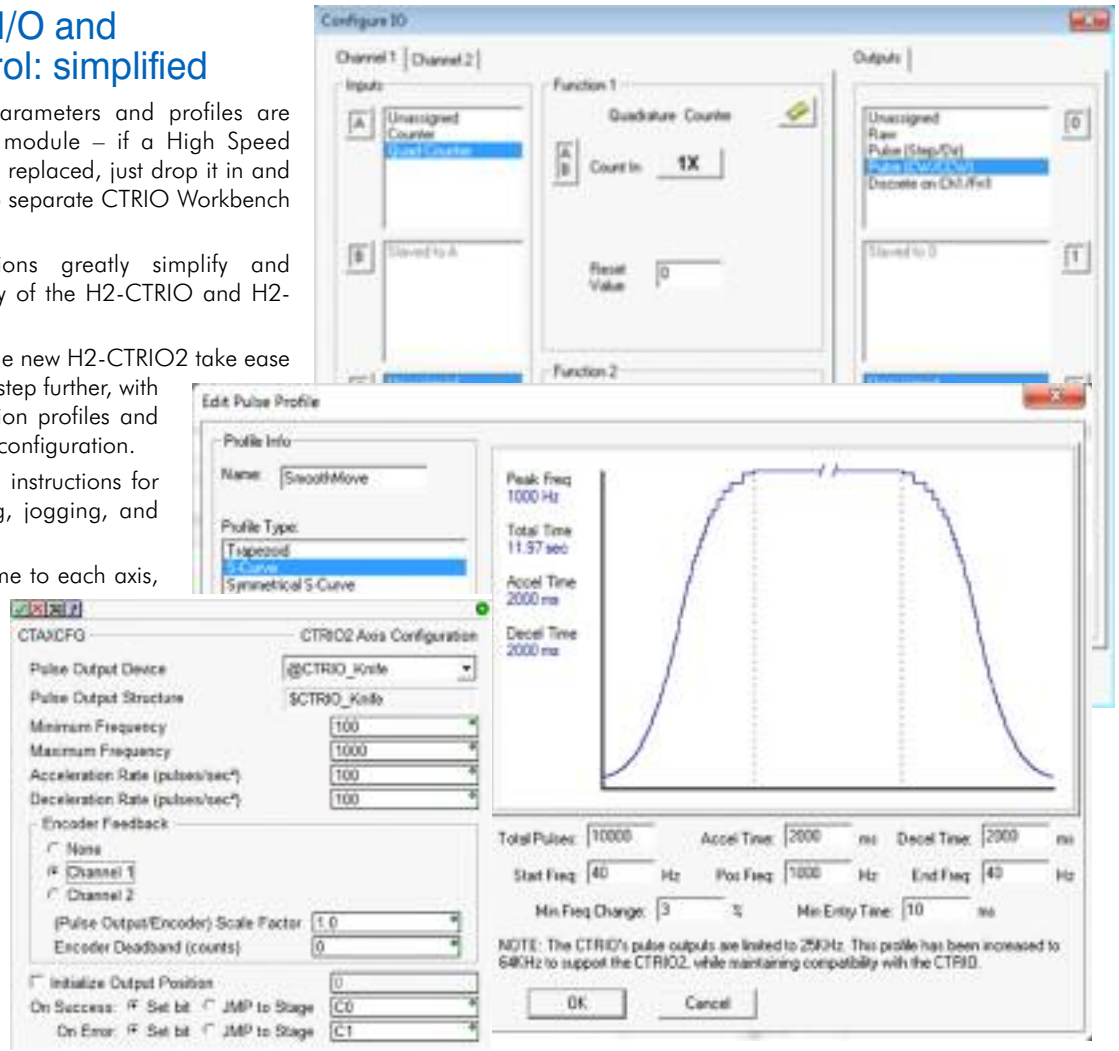
All configuration parameters and profiles are stored in the CPU module – if a High Speed Module needs to be replaced, just drop it in and reboot. (There is no separate CTRIO Workbench application.)

Dedicated instructions greatly simplify and improve functionality of the H2-CTRIO and H2-CTRIO2 modules.

Native support for the new H2-CTRIO2 take ease of use and power a step further, with fill-in-the-blank motion profiles and high-speed counter configuration.

Use the 'Axis Mode' instructions for dynamic positioning, jogging, and trapezoidal moves.

Assign a logical name to each axis, and use that name throughout your code!



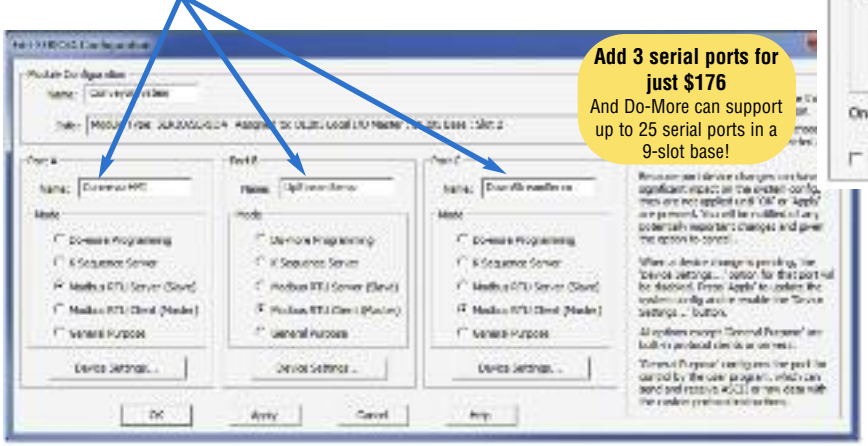
Communications are easy to define, troubleshoot

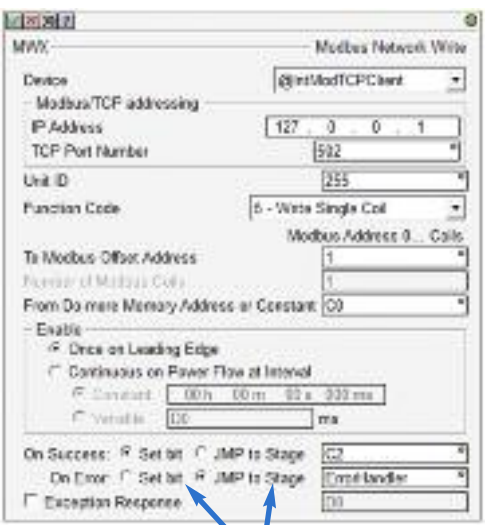
The **PEERLINK** instruction makes it very easy to share data over Ethernet between Do-more CPUs, with transparent data sharing in a designated memory area.

Do-more supports the H2-SERIO and H2-SERIO-4 modules for easy, cost-effective addition of serial ports.

Do-more offers more security in communications - Modbus and DirectLOGIC transactions reference reserved "Guest Memory" (Modbus and DL memory) so there is no direct access to your I/O image registers from other devices.

Do-more lets you ***name your devices*** and reference those meaningful names throughout your program code.





All Communication instructions can either:

- Set a flag, OR
- Jump to Stage

"on success" or "on error". This can really simplify your code!

The software story just gets better and better!

Insightful monitoring and troubleshooting tools

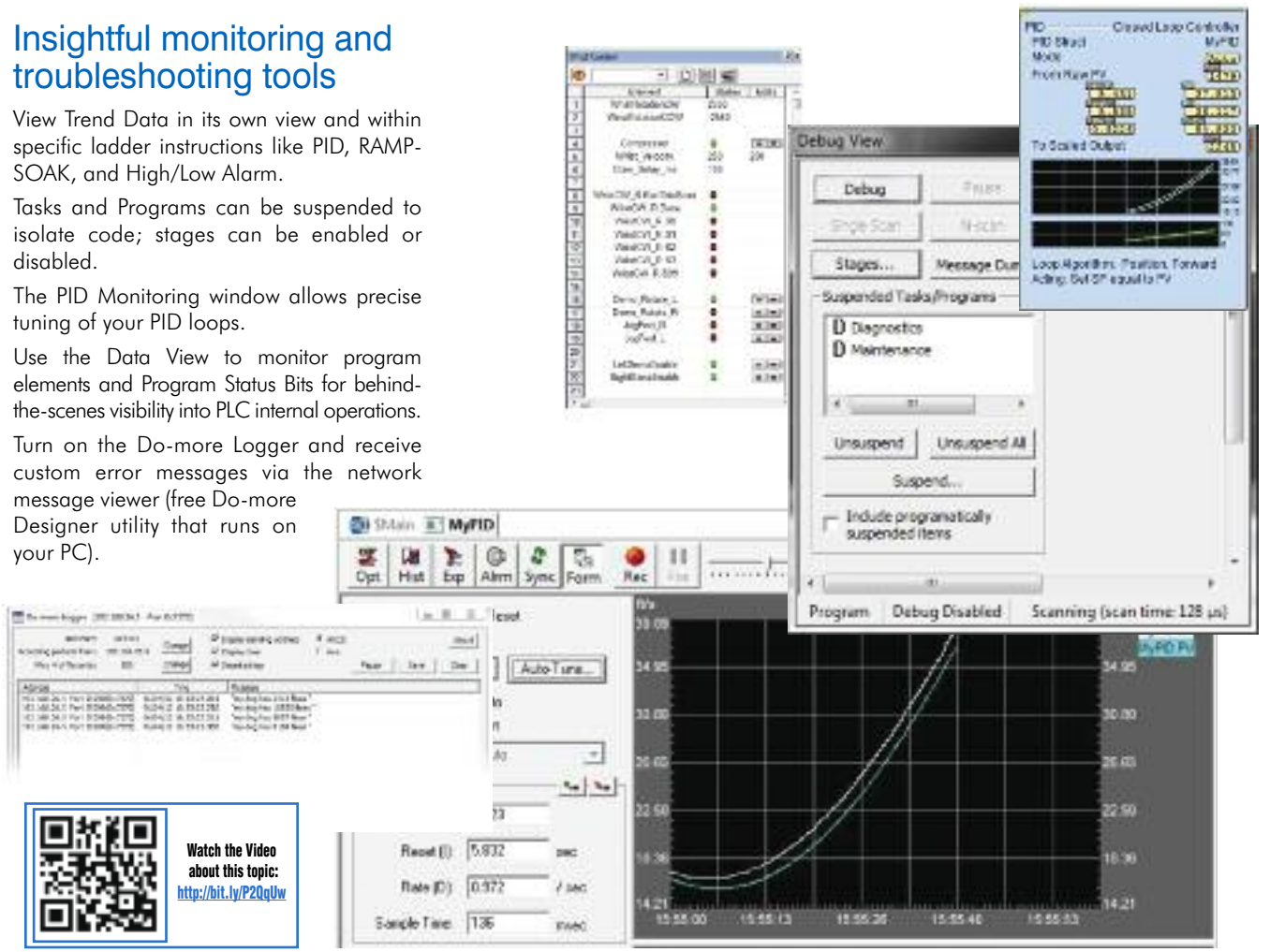
View Trend Data in its own view and within specific ladder instructions like PID, RAMP-SOAK, and High/Low Alarm.

Tasks and Programs can be suspended to isolate code; stages can be enabled or disabled.

The PID Monitoring window allows precise tuning of your PID loops.

Use the Data View to monitor program elements and Program Status Bits for behind-the-scenes visibility into PLC internal operations.

Turn on the Do-more Logger and receive custom error messages via the network message viewer (free Do-more Designer utility that runs on your PC).



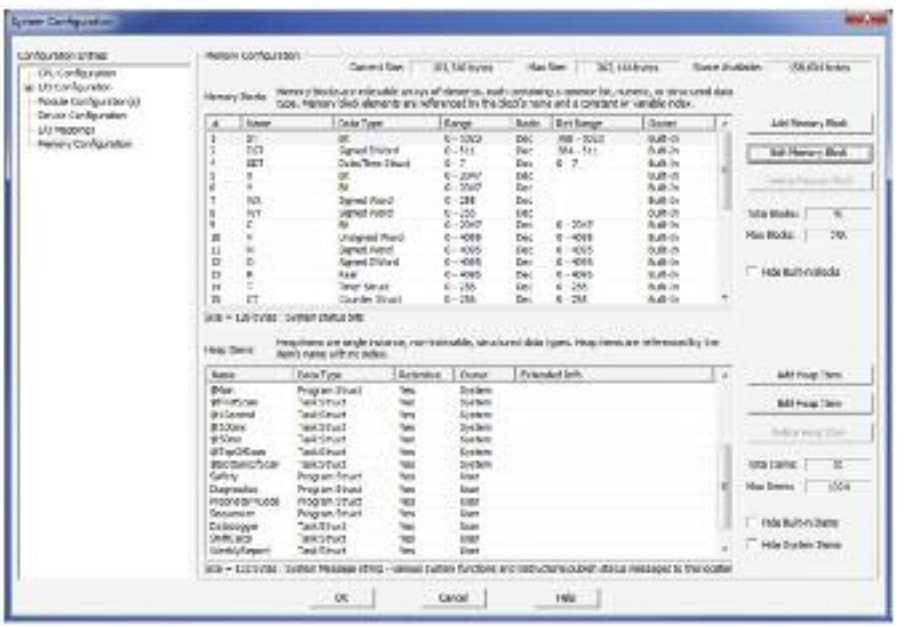
Watch the Video about this topic:
http://bit.ly/P2QqUw

Flexible memory management capabilities

Strong data typing keeps your data organized and protected. Data structures automatically put the important details at your fingertips.

Do-more can be as flexible as you need. You can allocate all that data memory the way you want it up to specific maximums (no more rigid, predefined blocks of wasted space!).

You can even define your custom memory addresses and assign a data type of your choice to improve the readability of your program.



Organize your code with outstanding program management tools

Do-more supports a mix of stage and ladder for a best-of-both-worlds approach that simplifies your code and makes troubleshooting easier.

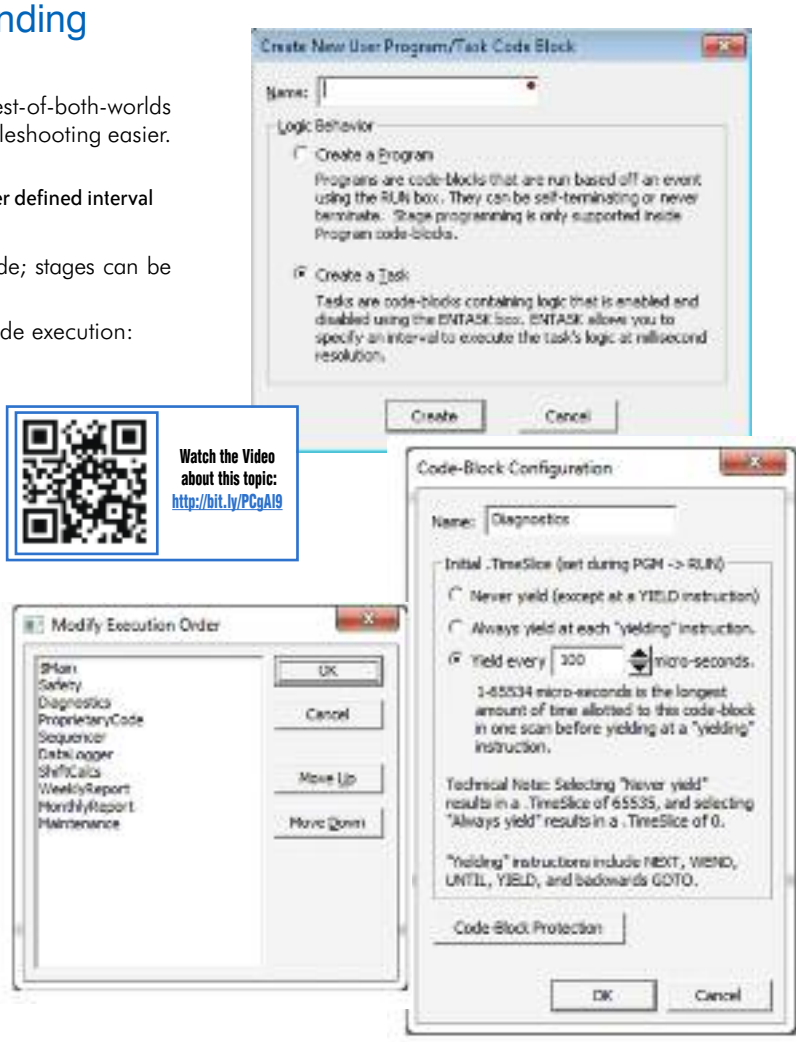
Code can be broken up into Tasks and Programs:

- **Tasks run when called; once, continuously, or at a user defined interval**
- **Programs run based on events**

Tasks and Programs can be suspended to isolate code; stages can be enabled or disabled.

Get flexible, powerful control over your program code execution:

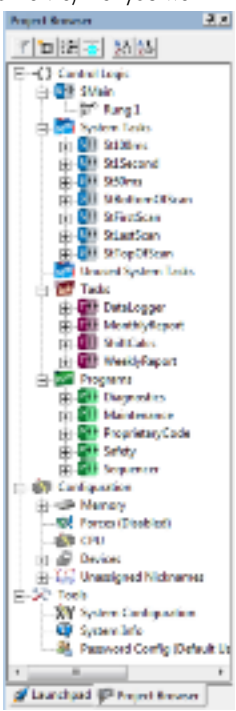
- **Assign tasks or programs a fixed timeslice**
- **Define "yield points" for logical pauses**
- **Define priorities and order of execution**



Project management

All project files are stored onboard the CPU - no more searching for the old laptop with the most recent copy of the program before you can fix your machine!

You can also store your own files with the disk-based version of the project to aid future improvement or troubleshooting efforts. Store PDF, HTML or virtually any file format (up to 10Mb) that you want to keep with the project for reference, or information to assist your coworkers or customers whenever they open the project.



The Project Browser makes it easy to select the code block you want to view or edit. System tasks are predefined for many common actions. Jump directly to any part of your code with just a few clicks.

The Do-more Designer software even supports "restore points", which are basically previous versions of your program that you saved at known good operation. It's nice to know that you can easily "roll back" your project if your development goes awry.

'Bumpless' Run-time Edits

Do-more Designer can download a new version of your code into the Do-more CPU and seamlessly switch to it **at the beginning of the next scan**. There is no need for any pause (however brief) that can wreak havoc on the operation of your machine or process.

Visit www.do-more.com for more details on all the hardware and software features, and to view all the videos.

Security for your code and your organization

Do-More Designer offers versatile password protection. Define multiple users, assigning combinations of privileges from the available options. Use code block password protection to allow customers to see enough of the program to allow basic troubleshooting, while keeping your proprietary code blocks hidden and secure.

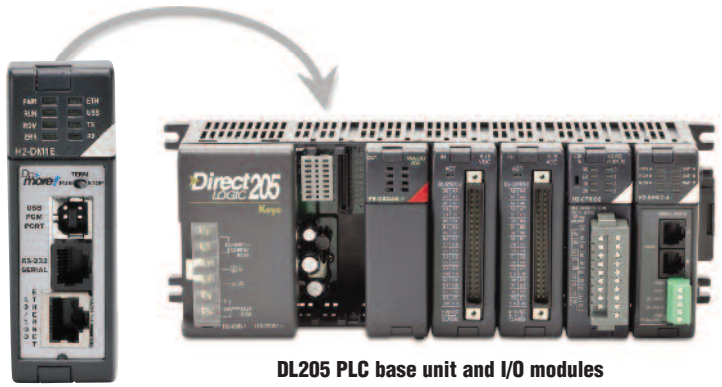
External devices are relegated to "guest memory" areas; your program code controls all access to actual I/O points. There are separate reserved areas for Modbus and DL memory (DL memory is used for remote I/O racks).

Code-Block Protection Level
Full Access
- The code-block can be viewed and modified without restriction.
Unlocked for this Project Session
- The code-block is password-protected, but can be viewed and modified until the project is closed.
Locked
Set Password
Set Protection Level
Cancel

Do-more H2 Series PLC Overview

Do-more H2 Series PLC Modules

The Do-more H2 Series PLC is the newest technology available that makes control applications easier to implement. It uses proven DirectLOGIC hardware as a platform for a powerful, flexible instruction set, with a user-friendly programming environment. The Do-more H2 Series PLC utilizes most of the modules that are part of the DL205 PLC family. You simply install a Do-more H2 Series CPU module into a DL205 base unit. However, the specifications of the Do-more H2 Series PLC are very different from the DL205 PLC. This overview covers the key features of the Do-more H2 Series PLC.



Do-more H2 CPU Module

DL205 PLC base unit and I/O modules

CPU modules

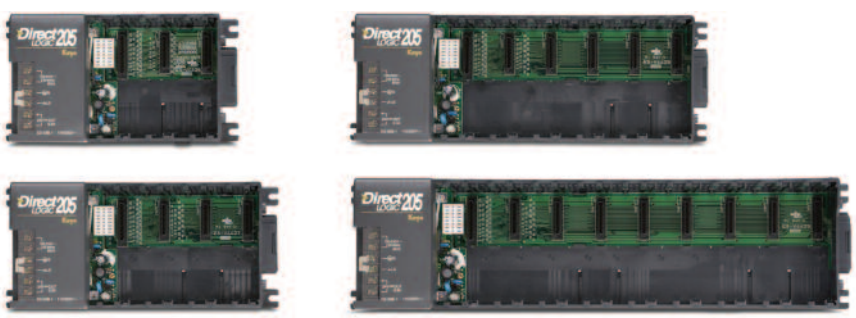
The Do-more H2 Series PLC offers two CPU modules available, H2-DM1 and H2-DM1E, both of which must be programmed using the Do-more Designer programming software. You cannot use the existing DL205 CPU modules (D2-230, D2-240, D2-250(-1) and D2-260) with Do-more Designer.

H2-DM1

H2-DM1E (with Ethernet)

Base units

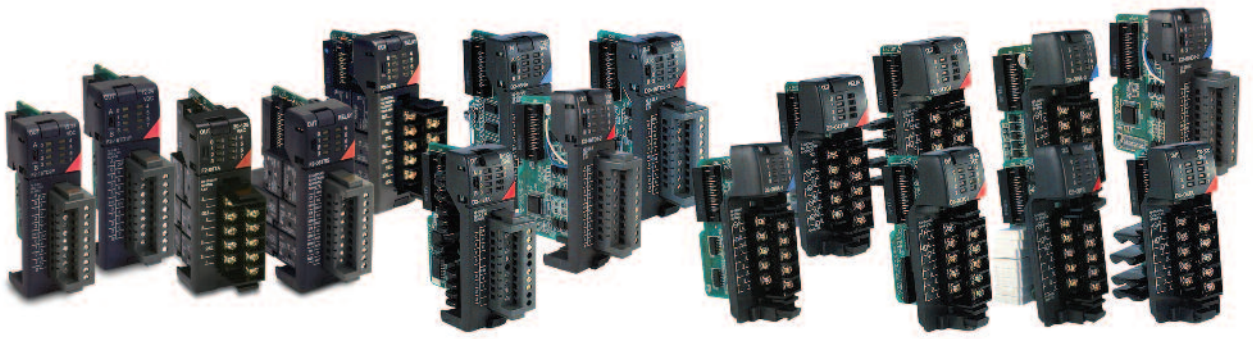
The Do-more H2 Series PLC supports all of the base units available for the DL205 PLC.



Do-more H2 Series PLC Overview

Discrete I/O modules

The Do-more H2 Series PLC supports all of the discrete I/O modules available for the DL205 PLC.



Analog I/O modules

The Do-more H2 Series PLC supports all of the analog I/O modules available for the DL205 PLC.

Do-more H2 Series PLC Overview

Specialty modules

The Do-more H2 Series PLC supports many of the specialty modules available for the DL205 PLC. The following modules are supported:

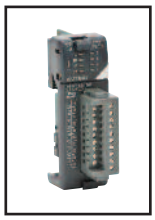
H2-ECOM100

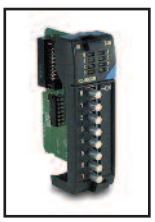
H2-SERIO

H2-SERIO-4

H2-ERM

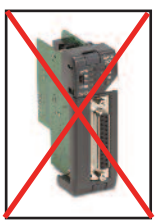
H2-CTRIO


H2-CTRIO2


F2-08SIM

Specialty modules NOT supported

The following modules are NOT supported by the Do-more H2 Series PLC.


D2-DCM

D2-RMSM

D2-CTRINT

F2-CP128

D2-EM

D2-CM

D2-RSSS

DV-1000

D2-HPP

Programming Software

The Do-more H2 Series PLC can only be programmed by Do-more Designer. (DirectSOFT programming software is not compatible with Do-more PLCs)

Do-more H2 Series PLC Overview

Module Compatibility

The following table shows which DL205 components are supported by the H2-DM1 and H2-DM1E Do-more CPUs.

Module Compatibility Table					
Module	**Part Number**	**Status**	**Module**	**Part Number**	**Status**
Base Units	D2-03B-1	✓	***Analog I/O Modules***	F2-04AD-1	✓
	D2-04B-1	✓		F2-04AD-2	✓
	D2-06B-1	✓		F2-08AD-1	✓
	D2-09B-1	✓		F2-08AD-2	✓
	D2-03BDC1-1	✓		F2-04RTD	✓
	D2-04BDC1-1	✓		F2-04THM	✓
	D2-06BDC1-1	✓		F2-02DA-1(L)	✓
	D2-09BDC1-1	✓		F2-02DA-2(L)	✓
	D2-06BDC2-1	✓		F2-02DAS-1	✓
	D2-09BDC2-1	✓		F2-02DAS-2	✓
Discrete I/O Modules	D2-08ND3	✓		F2-08DA-1	✓
	D2-16ND3-2	✓		F2-08DA-2	✓
	D2-32ND3	✓		F2-4AD2DA	✓
	D2-32ND3-2	✓		F2-8AD4DA-1	✓
	D2-08NA-1	✓		F2-8AD4DA-2	✓
	D2-08NA-2	✓	***Local Expansion Modules***	D2-CM	No
	D2-16NA	✓		D2-EM	No
	D2-04TD1	✓	***Specialty Modules***	H2-ERM	✓
	D2-08TD1	✓		H2-ERM-F	✓
	D2-08TD2	✓		D2-RMSM	No
	D2-16TD1-2	✓		D2-RSSS	No
	D2-16TD2-2	✓		H2-ECOM100	✓
	F2-16TD1P	✓		H2-ECOM-F	✓
	F2-16TD2P	✓		D2-DCM	No
	D2-32TD1	✓		H2-EBC100	✓
	D2-32TD2	✓		H2-EBC-F	✓
	D2-08TA	✓		H2-SERIO	✓
	F2-08TA	✓		H2-SERIO-4	✓
	D2-12TA	✓		F2-CP128	No
	D2-04TRS	✓		H2-CTRIO	✓
	D2-08TR	✓		H2-CTRIO2	✓
	F2-08TR	✓		D2-CTRINT	No
	F2-08TRS	✓		F2-08SIM	✓
	D2-12TR	✓	***Programmer***	D2-HPP	No
	D2-08CDR	✓	***Operator Interface***	DV-1000	No

✓ = Supported No = Not Supported

Do-more H2 Series PLC Overview

Communications

The Do-more H2 Series PLC supports many communication protocols. The following table shows which CPU module communications port or specialty module supports each protocol.

Protocols	CPU Modules			Specialty Modules			
	H2-DM1 / H2-DM1E		H2-DM1E	H2-ECOM100	H2-ECOM H2-ECOM-F	H2-SERIO H2-SERIO-4	H2-ERM H2-ERM-F
	USB Port	RS-232 Serial Port	Ethernet Port				
Do-more Designer Programming	Yes	Yes	Yes	Yes		Yes	
Modbus/RTU Client (Master)		Yes				Yes	
Modbus/RTU Server (Slave)		Yes				Yes	
Modbus/TCP Client (Master)			Yes	Yes			
Modbus/TCP Server (Slave)			Yes	Yes			
DirectLOGIC RX/WX Client (Master)			Yes	Yes	Yes		
DirectLOGIC RX/WX Server (Slave)			Yes	Yes	Yes		
K-Sequence Server (Slave)		Yes		Yes	Yes	Yes	
DirectNET Server (Slave)				Yes	Yes		
HEI Ethernet Remote I/O Master							Yes
SMTP (EMail) Client w/Authentication			Yes				
Simple Network Time Protocol (SNTP) Client			Yes				
Do-more/PEERLINK			Yes				
Do-more Time Synchronization Protocol (Client, Server, Alternate Client)			Yes				
Do-more Logger/UDP			Yes				
Serial ad-hoc ASCII/Binary Programatic Control		Yes				Yes	
UDP ad-hoc Programmatic Control			Yes				
TCP Client Programmatic Control			Yes				
TCP Server Programmatic Control			Yes				

Blank = Not Supported

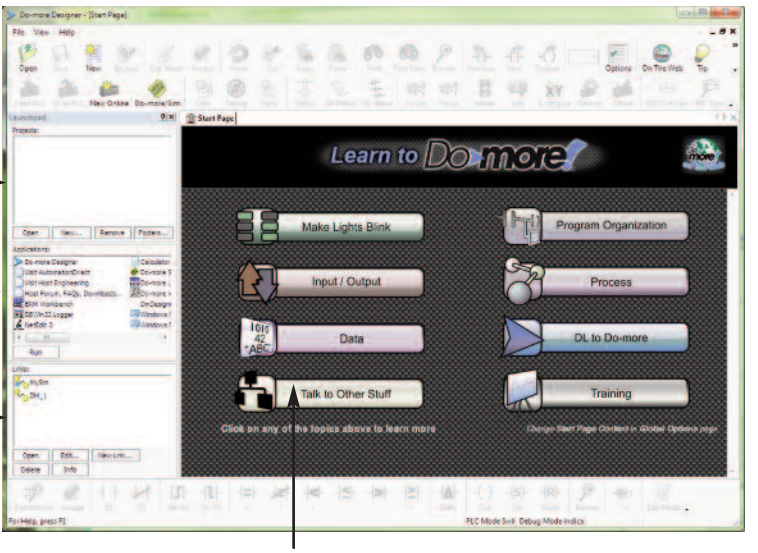
Do-more H2 Series PLC Overview

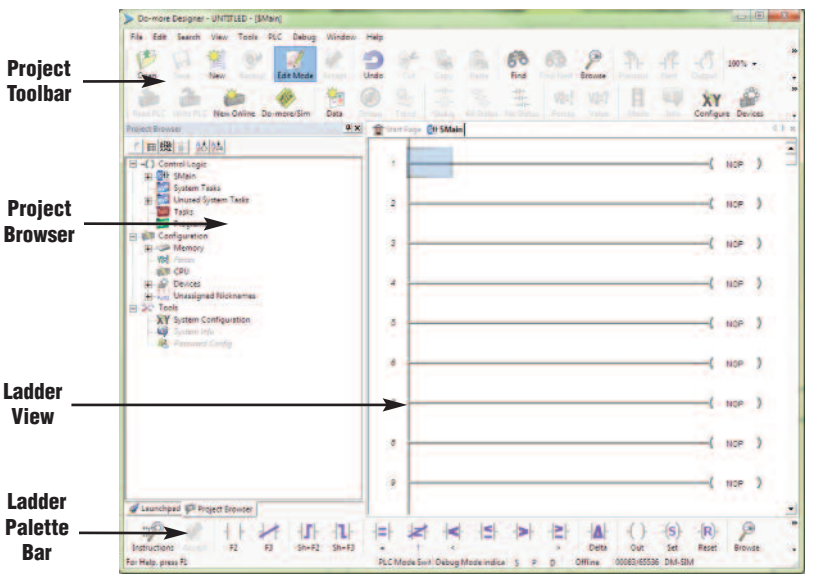
Do-more Designer (Part No. DM-PGMSW)

Do-more Designer is the full-featured programming software for the Do-more PLC series. Do-more Designer is a free download from Automationdirect.com. A CD-ROM version is also available for purchase.

Start Page

When the software is started, the Start Page is displayed. This page contains a Launchpad with Projects, Applications and Links windows. It also contains shortcuts to important help file topics and the Do-more Simulator.





Main Programming Window

The Main Programming Window is displayed when a new program is started or an existing program is opened. It is divided into Menus, Toolbars, and Windows that work together to make project development as simple as possible.

Do-more H2 Series PLC Overview

Do-more Designer Features

Do-more Designer has the following main features:

- Supports the Do-more PLC instruction set
- Project Browser (Window to organize the user project)
- Data View (Interface to monitor PLC data in a list)
- Trend View (Interface to monitor PLC data with trend graphs)
- PID View (Interface to monitor and tune the individual PID control loop)
- PID Overview (Interface to monitor multiple PID control loops)
- Debug View (Interface to debug the ladder programs)

When Do-more Designer is installed on your PC, the following tools are also installed:

- Do-more Simulator (Offline simulator of ladder program execution and PID control)
- Do-more Logger (Software tool to log PLC data)
- ERM Workbench (Configuration tool for the ERM modules)
- NetEdit 3 (Configuration tool for the ECOM/EBC Ethernet modules)

PC Requirements

The Do-more Designer Windows-based programming software works with Windows® XP (Home or Professional, 32-bit), Vista (Home, Basic, Premium, 32 or 64-bit) or Windows 7 (Home, Professional, Ultimate, 32 or 64-bit). Please check the following requirements when choosing your PC configuration:

- Minimum PC to PLC Connectivity, at least one of the following:
  - USB Port: connects to the CPU with USB-A connector (USB-A to USB-B cable)
  - RS-232 Serial Port: connects to the CPU with RJ-12 connector (RJ-12 to DB9 or RJ-12 to USB-B serial converter cable)
  - Ethernet Port: connects to the CPU (H2-DM1E) with RJ-45 10Base-T or 100Base-T (Cat5 Patch Cable)
- Hard Disk: 100MB free disk space
- Video Display: 1024x768, 256 colors resolution (1280x720, true color recommended)
- Windows XP, 32-bit:
  - 800MHz, single core CPU (2GHz, multi-core or hyperthreaded recommended)
  - 512MB RAM (2GB recommended)
- Vista or Windows 7, 32 or 64-bit:
  - 1GHz, single core CPU (2GHz, multi-core recommended)
  - 1GB RAM (3GB recommended)

Programming Cables

The Do-more H2 Series CPU module H2-DM1 has two communication ports (USB and RS-232 serial) and the H2-DM1E has three communication ports (USB, RS-232 serial and Ethernet). You can use any of those ports for programming and monitoring. Needed cables for these ports are listed below and can be purchased at Automationdirect.com.

USB Cables (USB 2.0, Type A-B connectors) available:

- USB-CBL-AB3 (3 ft.)
- USB-CBL-AB6 (6 ft.)
- USB-CBL-AB10 (10 ft.)
- USB-CBL-AB15 (15 ft.)

RS232 Serial Cable

- D2-DSCBL (12 ft. 9-pin D-sub to RJ12 connector)

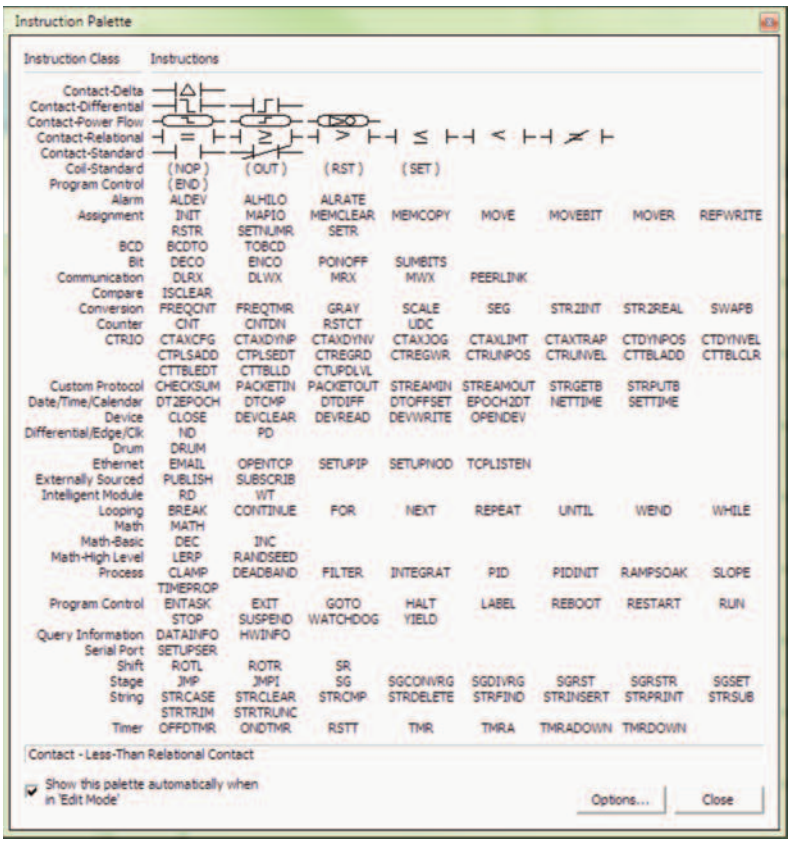
Ethernet Cables (Cat5e)

Automationdirect.com sells many Ethernet patch cables in various colors and lengths. Please check the Cables section in this catalog for further details.

Do-more H2 Series PLC Overview

Do-more PLC Instruction Set

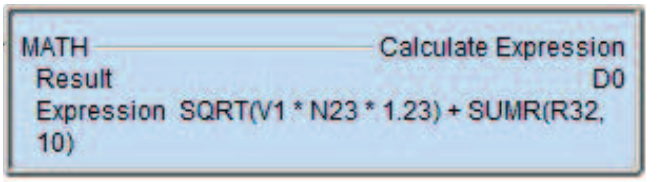
This Instruction Set was developed specifically for the new Do-more PLC; the 'Instruction Palette' displays all available instructions.



You may see some similarities to the DirectLOGIC PLC instruction set. However, the instruction set for the Do-more PLC is more advanced and intuitive. A good example is the MATH instruction. Now, just one MATH instruction covers all math operations and also allows you to mix different data types in one expression.

There are over 60 operators and functions available with the MATH instruction.

Note: To learn more about the MATH instruction, please refer to the Do-more Designer help topic 'MATH – Math Expression'.



Operators

+, -, *, /, %, **, <, <=, ==, !=, >=, >, &&, ||, &, |, ^, <<, >>, >>>, -, ~, !

Functions

ABS, ACOS, ASIN, ATAN, AVGR, COS, COUNTIFEQ, COUNTIFNE, COUNTIFGE, COUNTIFGT, COUNTIFLE, COUNTIFLT, DEG, E, FRAC, IF, LN, LOG, MAXR, MAX, MINR, MIN, NOW, PI, RAD, RANDINT, RANDREAL, REF, ROUND, SIN, SQRT, STDEVR, STDEVPR, SUMIFEQ, SUMIFNE, SUMIFGE, SUMIFGT, SUMIFLE, SUMIFLT, SUMR, TAN, TICKms, TICKus, TOINT, TOREAL, TRUNC

Do-more H2 Series PLC Overview

Data Types

The Do-more PLC supports the following seven primary data types:

- Bit (0 or 1)
- Unsigned Byte (0 to 255)
- Signed Byte (-128 to 127)
- Unsigned Word (0 to 65,535)
- Signed Word (-32,768 to 32,767)
- Signed DWord (-2,147,483,648 to 2,147,483,647)
- Real (-3.4028235E+038 to 3.4028235E+038)

Note: As you can see, the BCD data type that is popular for the DirectLOGIC PLC is not included in this list. However, you can use the BCDTO and TOBCD instructions if you need to use the BCD data type with your application. Those instructions convert the data between the BCD data type and the integer/real data types.

Data Structure

The Do-more PLC supports data structures as additional data types. Structures use the familiar PC programming organization of "dot notation". All available elements of a structure are shown in this format. The following data structures are currently available:

- Timer Structure
- Counter Structure
- String Structure
- PID Structure
- Date/Time Structure
- Task Structure
- Rampsoak Structure
- Program Structure
- DeviceRef Structure
- Drum Structure

The data structure is a set of data. For instance, a Timer structure (Timer Struct) has the following set of data:

- Acc (Accumulated Time, Signed DWord)
- Done (Bit)
- Zero (Bit)
- Timing (Bit)
- Reset (Bit)

When you use a timer instruction (TMR), a Timer structure is assigned to the instruction. If you select 'T0', you can access the above data with dot notation. For instance, to access the accumulated time (Acc), enter 'T0.Acc'. To access the Done bit, enter 'T0.Done'.

Memory Addressing

With the Do-more PLC, each memory address type has its own specific data type. Here are some examples:

- V (Unsigned Word)
- N (Signed Word)
- D (Signed DWord)
- R (Real)

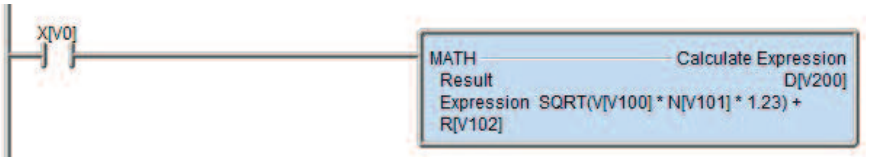
If you see address 'V123' in the ladder program, the memory address always stores an Unsigned Word value. With this memory addressing method, it becomes easier to read and write the ladder programs.

Although most of the memory addressing is decimal, the memory addresses DLX, DLY, DLC and DLV use octal. These four memory addresses can be used to exchange data with DirectLOGIC PLCs, which use octal memory addressing.

Do-more H2 Series PLC Overview

Array Addressing

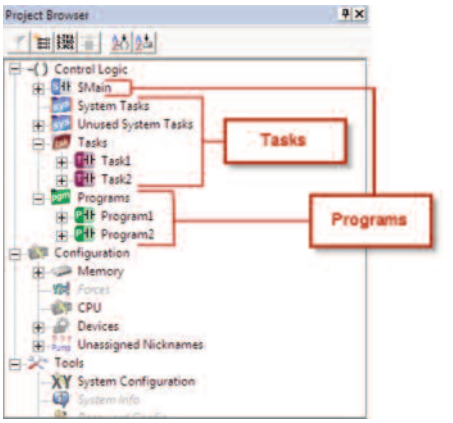
The Do-more PLC supports array addressing with all memory addresses. V-memory address must be used as the index for an array. With the Do-more PLC, the following ladder program is valid.



Note: In this example, V0, V100, V101, V102 and V200 are indices.

Code-block, Program and Task

One Do-more project can consist of more than one ladder program. Each ladder program is called a 'Code-block'. The Do-more PLC supports two types of code-blocks, Program and Task. Here are their definitions.



Program

Programs are code-blocks that run based on an event using the RUN instruction. They can be self-terminating or never terminate. Stage programming is only supported inside Program code-blocks.

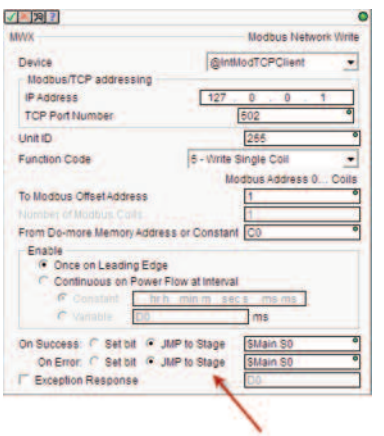
Task

Tasks are code-blocks that are enabled and disabled using the ENTASK instruction. The ENTASK instruction allows you to specify an interval to execute the task's logic with a millisecond resolution or to execute a single time on a leading edge input.

Stages

The Do-more PLC supports Stages. You can use Stages only in the Program code-blocks. (They are not available in the Task code-blocks.) The Do-more PLC supports the following instructions for Stage Programming[1]:

- SG (SG)
- JMP (Jump To Stage)[2]
- JMPI (Index Jump)
- SGSET (Enable Stage)
- SGRST (Disable Stage)
- SGRSTR (Disable Range of Stages)
- SGCONVRG (Converge Multiple Stages to SG)
- SGDIVRG (Jump to Multiple Stages)



[1] There is no ISG (Initial Stage) instruction for the Do-more PLC; the first stage in the Program code-block becomes the initial stage automatically.

[2] Many asynchronous instructions can directly initiate a Jump to Stage.

Do-more H2 Series PLC Overview

Comparison with the DL205 PLC

The following spec table shows the major differences between the Do-more H2 Series PLC and the DL205 PLC.

	Do-more H2 Series PLC	DL205 PLC
Instruction Set	Do-more PLC instruction set	DirectLOGIC PLC instruction set
Total Memory Bytes	262.1K	30.4K
Default Data Type	Decimal and Real (Data can be referred in different data types with the 'Casting' feature.)	BCD, HEX and Real
Memory Addressing	Decimal mainly (There are some octal memory addresses to exchange data with DirectLOGIC PLCs easily.)	Octal
User-defined Memory Addresses	Yes	No
Bit of Memory	Available for all memory addresses (e.g. V100.2, D200.3)	Yes, D2-250(-1) and D2-260 only
Array Addressing	Available for all memory addresses (e.g. X[V100], D[V200])	Available only for V-memory addresses (e.g. P2000)
Math Calculation	No accumulator, the MATH instruction can support a mix of different data types.	Using accumulator or using the MATHBCD, MATHBIN or MATHR instruction for each data type.
Number of Code Blocks	1 system program 6 system tasks Up to 256 user programs Up to 256 user tasks	1
Looping	FOR-NEXT, WHILE-WEND, REPEAT-UNTIL	FOR-NEXT
Subroutines	No (Use Code-blocks)	Yes
User Document (Nicknames, Rung Comments…) Storing	Stored in the CPU module	No (Stored on PC only)
Password Protection	Multiple passwords	Single password
Run-time Editing	Bumpless	Ladder program execution is paused during the ladder program transfer in RUN mode.
Analog I/O Configuration	The X, WX and WY addresses are assigned to analog I/O channels automatically. (Manual addressing is available also.)	Configured by ladder program
Local Base Expansion	No	Yes (with D2-EM and D2-CM)
Number of PID Loops	Over 2000	4 (D2-250-1), 16 (D2-260)
Memory Back-up Battery	Included	Optional
Firmware Update	CPU module firmware can be updated from Do-more Designer.	Use firmware update tool
Built-in RS-232 Port	Yes, Full duplex	Yes, Half duplex
Built-in USB Port	Yes	No
Built-in Ethernet Port	Yes (H2-DM1E)	No
Programming Software	Do-more Designer	DirectSOFT

Do-more H2 Series PLC System Specifications

General Specifications

General Specifications	
Operating Temperature	32°F to 131°F (0°C to 55°C)
Storage Temperature	–4°F to 158°F (–20°C to 70°C)
Ambient Humidity	30% to 95% relative humidity (non–condensing)
Environmental Air	No corrosive gases
Vibration	MIL STD 810C, Method 514.2 IEC60068-2-6 JIS C60068-2-6 (Sine wave vibration test)
Shock	MIL STD 810C, Method 516.2 IEC60068-2-27 JIS C60068-2-27
Noise Immunity	NEMA ICS3-304
Agency Approvals	UL508 (File No. E157382, E316037) CE (EN61131-2)

CPU Modules

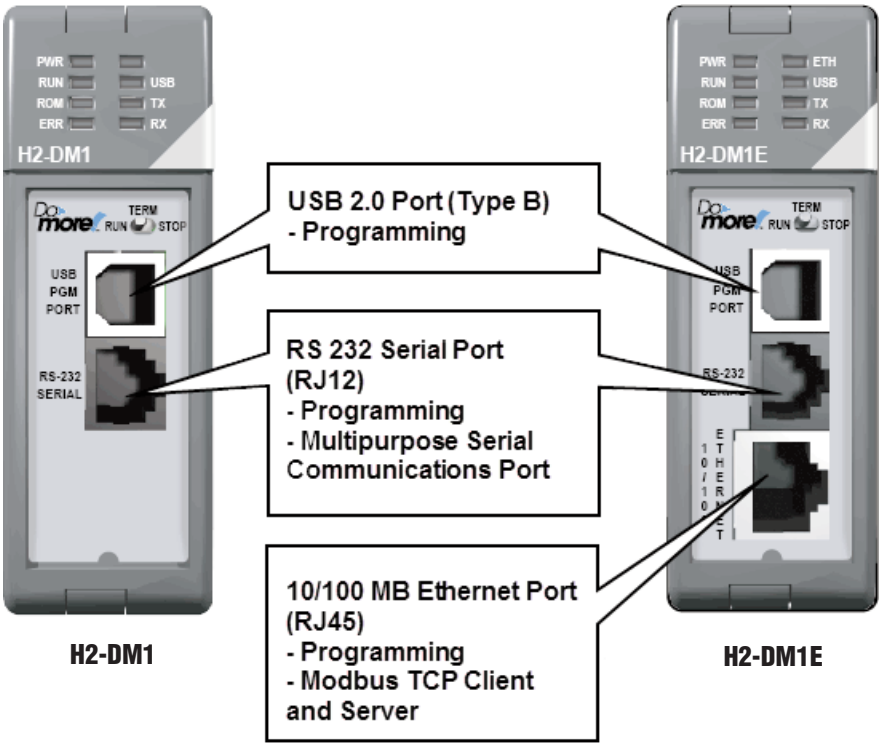
Specifications

H2-DM1 <--->

H2-DM1E <--->

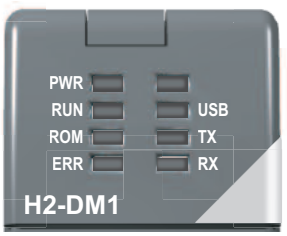
Feature	H2-DM1	H2-DM1E
Total Memory (bytes)	262,144 bytes	
Ladder Memory (instruction words)	65,536 instruction words	
V-Memory (words)	Configurable up to 65536 (4096 default)	
Non-volatile V Memory (words)	Configurable up to 65536 (4096 default)	
D-memory (DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile D Memory (DWORDs)	Configurable up to 65536 (4096 default)	
R-memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Non-volatile R Memory (REAL DWORDs)	Configurable up to 65536 (4096 default)	
Boolean execution/K	50 uSec	
Stage Programming	Yes	
Number of Stages	128 per Program code-block; number of code-blocks configurable to memory limit	
Handheld Programmer	No	
Programming Software for Windows	FREE Do-more Designer	
Built-In communications ports	USB, RS-232	USB, RS-232, Ethernet (10/100 Base-T)
Program Memory	Flash ROM	
Total I/O points available	X, Y, each configurable up to 65536 (2048 default); WX, WY (analog in/out) each configurable up to 65536 (256 default)	
Local I/O points available	256	
Ethernet Remote I/O Discrete points	131,072	
Ethernet Remote I/O Analog I/O Channels	32,768	
Max Number of Ethernet slaves per Channel	16	
I/O points per Remote Channel	32,768	
Discrete I/O Module Point Density	4/8/12/16/32	
Slots per Base	3/4/6/9	
Number of instructions available	>160	>170
Control relays	Configurable up to 65536 (2048 default)	
Special relays (system defined)	1024	
Special registers (system defined)	512	
Timers	Configurable up to 65536 (256 default)	
Counters	Configurable up to 65536 (256 default)	
System Date/Time structures	8	
User Date/Time structures	Configurable up to 65536 (32 default)	
ASCII String/Byte buffer structures	Configurable up to memory limit (192 default)	
Modbus Client memory	Yes, configurable up to memory limit, default 1024 input bits, 1024 coil bits, 2048 input registers, 2048 holding registers	
DL Classic Client memory	Up to memory limit, default 512 X, 512 Y, 512 C, 2048 V	
Immediate I/O	No	
Interrupt input (hardware / timed)	No	
Subroutines	Program and Task code-blocks, up to memory limit	
Drum Timers	Yes, up to memory limit	
Table Instructions	Yes	
Loops	FOR/NEXT, WHILE/WEND, REPEAT/UNTIL loops	
Math	>60 operators and functions: Integer, Floating Point, Trigonometric, Statistical, Logical, Bitwise, Timing	
ASCII	Yes, IN/OUT, Serial, Ethernet TCP and UDP; 11 output script commands	
PID Loop Control, Built In	Yes, configurable to memory limit (over 2,000)	
Time of Day Clock/Calendar	Yes	
Run Time Edits	Yes	
Supports True Force	Yes	
Internal Diagnostics	Yes	
Password security	Multi-user, credentialed, session-based security	
System error log	Yes	
User error log	Yes	
Battery backup	Yes (Battery included)	

CPU Modules

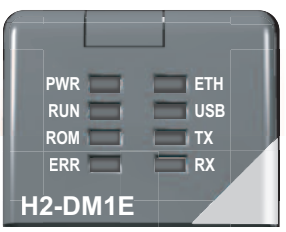


H2-DM1 **H2-DM1E**

LED Status Indicators



H2-DM1



H2-DM1E

LED Indicators		
Indicator	**Status**	**Description**
PWR	Green	Base Power ON
	Yellow	Low Battery
RUN	Green	CPU is in RUN Mode
	Yellow	Forces are Active
ROM	Yellow	CPU is updating Non-volatile Memory
ERR	Red	CPU Fatal Error
ETH	Green	Ethernet Link Good
	Yellow	Ethernet Activity
USB	Green	USB Receive Activity
	Yellow	USB Transmit Activity
TX	Green	RS-232 Transmit Activity
RX	Green	RS-232 Receive Activity

PLC Mode Switch

Mode Switch Functions	
Mode Switch Position	**CPU Action**
RUN (Run Program)	CPU is forced into RUN Mode if no errors are encountered.
TERM (Terminal)	RUN, PROGRAM and DEBUG modes are available. In this mode, the mode of operation can be changed through the Programming Software.
STOP (Stop Program)	CPU is forced into STOP Mode.

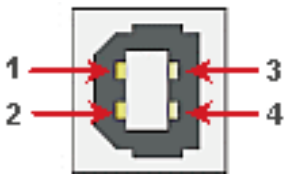
CPU Modules

Communication Ports

USB Port

Used exclusively for programming and monitoring via a PC running Do-more Designer.

USB Port Specifications	
Description	Standard USB 2.0 Slave input for programming and online monitoring, with built-in surge protection. Not compatible with older full speed USB devices.
Cables (ADC part #)	USB Type A to USB Type B: USB-CBL-AB3 (3 ft.) USB-CBL-AB6 (6 ft.) USB-CBL-AB10 (10 ft.) USB-CBL-AB15 (15 ft.)



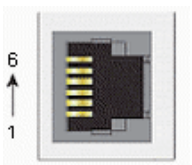
Pin	Description	
1	5V	Bus Voltage Sense
2	D-	Data -
3	D+	Data +
4	0V	Ground

RS-232 Port

RJ-12 style connector used for:

- Connection to a PC running Do-more Designer
- Modbus RTU Master connections
- Modbus RTU Slave connections
- ASCII Incoming and Outgoing communications
- Custom Protocol Incoming and Outgoing communications

RS-232 Port Specifications	
Description	Non-isolated, full duplex RS-232 DTE port used for programming, online monitoring or can connect the CPU as a Modbus RTU or ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection.
Baud Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200
+5V Cable Power Source	220 mA maximum at 5V, +/- 5%. Reverse polarity and overload protected.
Maximum Output Load (TXD/RTS)	3 KΩ, 1,000 pf
Minimum Output Voltage Swing	+/-5V
Output Short Circuit Protection	+/-15 mA
Cable Options (ADC part #)	D2-DSCBL FA-CABKIT FA-ISOCON for converting RS-232 to isolated RS-422/485



6-pin RJ12 Female Modular Connector

Pin	Description	
1	0V	Power (-) connection (GND)
2	5V	Power (+) connection (220 mA max.)
3	RXD	Receive Data (RS-232)
4	TXD	Transmit Data (RS-232)
5	RTS	Request to Send (RS-232)
6	CTS	Clear to Send (RS-232)

For a list of protocols supported by each port, please refer to the Communications topic of the Do-more H2 Series PLC Overview in this section.

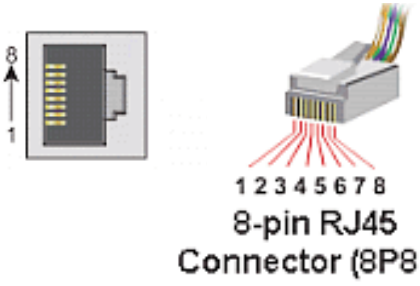
CPU Modules

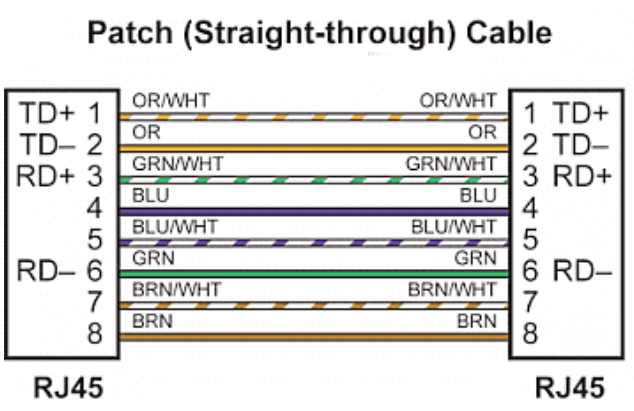
Ethernet Port

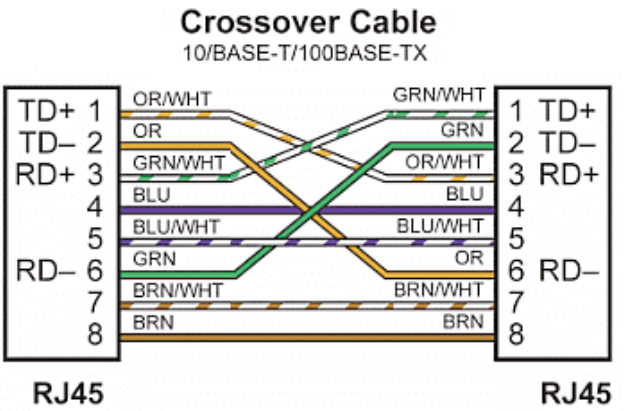
RJ-45 style connector used for:

- Connection to a PC running Do-more Designer
- Modbus TCP Client connections (Modbus requests sent from the CPU)
- Modbus TCP Server connections (Modbus requests received by the CPU)

Ethernet Port Specifications	
Description	Standard transformer isolated Ethernet port with built-in surge protection for programming, online monitoring and Modbus/TCP client/server connections (fixed IP or DHCP).
Transfer Rate	10/100 Mbps
Cables	Use a Patch (straight through) cable when a switch or hub is used. Use a Crossover cable when a switch or hub is not used.







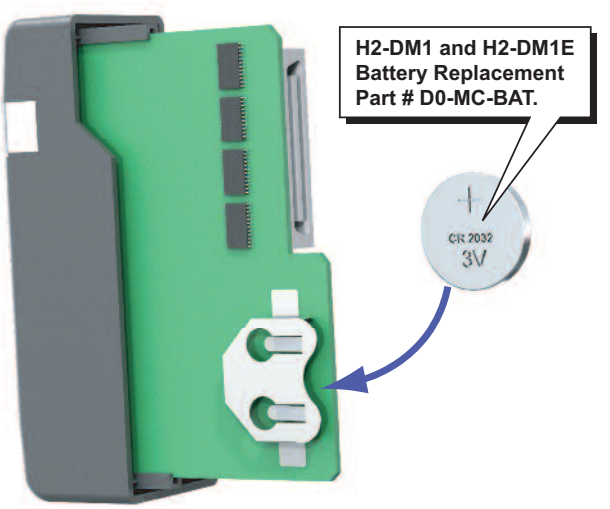
For a list of protocols supported by each port, please refer to the Communications topic of the Do-more H2 Series PLC Overview in this section.

Battery Specifications

A battery is included with the Do-more CPU and is used to retain the Time and Date along with any Tagname values that are set up as retentive. It is recommended that the battery be replaced once every five years or when one year of cumulative OFF time has been exceeded.

Up to two hours is allowed to change out a battery without loss of data.

Battery	
D0-MC-BAT	Coin type, 3.0V Lithium battery, number CR2032



Base Units

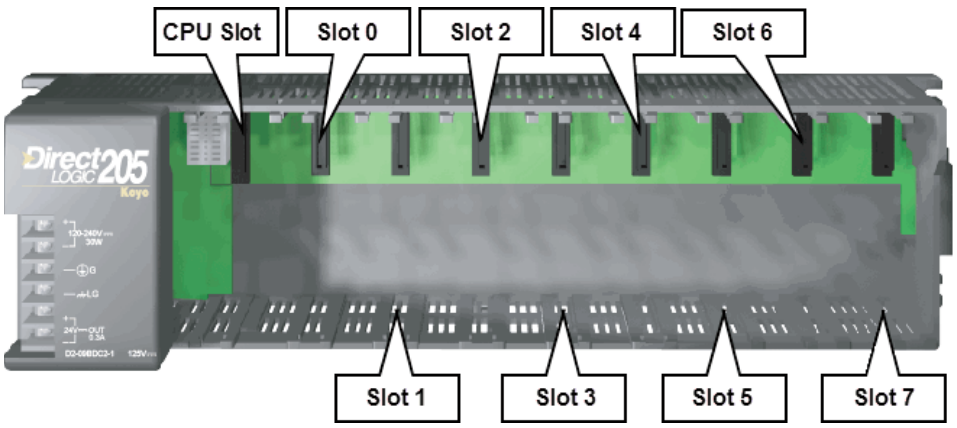
To use the Do-more H2 Series PLC, you must have at least one base unit. A base unit has an internal power supply that converts the input power (110-220VAC, 24VDC or 125VDC) to 5VDC in order to activate the modules installed in the base unit. For the Do-more H2 Series PLC, 10 types of base units are available.

Base Unit Part Numbers

Number of Module Slots	Input Power Type		
	110-220 VAC	24 VDC	125 VDC
3 slot	D2-03B-1	D2-03BDC1-1	-
4 slot	D2-04B-1	D2-04BDC1-1	-
6 slot	D2-06B-1	D2-06BDC1-1	D2-06BDC2-1
9 slot	D2-09B-1	D2-09BDC1-1	D2-09BDC2-1

In the base unit, the far left slot is called the 'CPU Slot'. It is used for a CPU or base controller. Optional modules (discrete I/O modules, analog I/O modules, and specialty modules) can be installed in the other slots. For instance, if you pick a base unit with **nine** slots, you can install up to **eight** optional modules.

Module Slots are numbered from left to right starting with zero. The slot to the right of the CPU slot is Slot 0, the slot to the right of it is Slot 1 and so on. The following is an example with the nine slot base unit D2-09B-1.



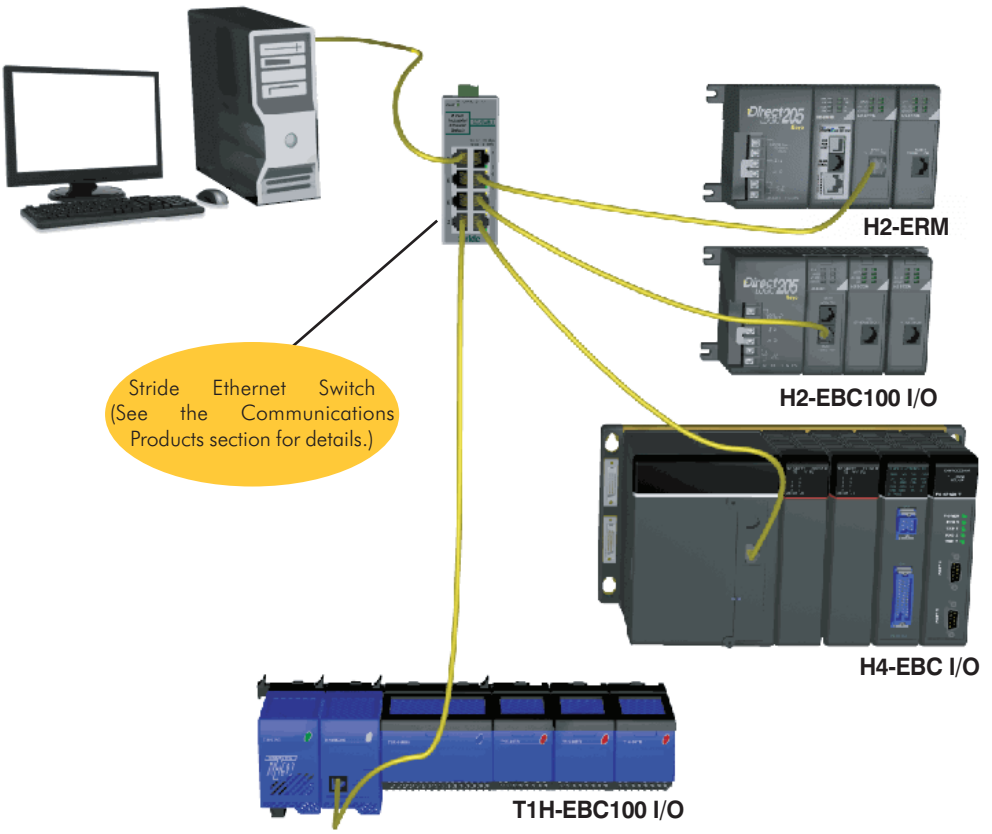
The following is a detailed specification table for the base units.

Power Supply Specifications			
Specification	**AC Powered Bases**	**24 VDC Powered Bases**	**125 VDC Powered Bases**
Part Numbers	D2-03B-1, D2-04B-1, D2-06B-1, D2-09B-1	D2-03BDC1-1, D2-04BDC1-1, D2-06BDC1-1, D2-09BDC1-1	D2-06BDC2-1, D2-09BDC2-1
Voltage Withstand (dielectric)	1 minute @ 1,500 VAC between primary, secondary, field ground, and run relay		
Insulation Resistance	> 10 MΩ at 500 VDC		
Input Voltage Range	85-132 VAC (110 range) 170-264 VAC (220 range) 47-63 Hz	10.2-28.8 VDC (24 VDC) with less than 10% ripple	100-264 VDC (125 VDC) with less than 10% ripple
Auxiliary 24 VDC Output	300 mA max.	none	300 mA max.
Maximum Inrush Current	30A	10A	20A
Maximum Power	80 VA	25W	30W

Base Units

I/O Expansion

When you need to use more than eight optional modules or you need to install base units in isolated locations, the Do-more H2 Series PLC supports the Ethernet remote I/O System.



Note for DL205 PLC customers

The Do-more H2 Series PLC does NOT support local expansion I/O with the D2-EM/D2-CM or serial remote I/O with the D2-RMSM.

Base Units

Module Placement and I/O Usage Tables

There are very few I/O module placement restrictions with the Do-more H2 Series PLC family. In general, any mix of analog and discrete module types can be used in any local or Ethernet remote base. However, specialty modules can't be used in the Ethernet remote base except for the F2-08SIM. Reference the Module Placement Restrictions table to the right for the Do-more H2 Series PLC.

Analog I/O in the Ethernet remote bases

When using an analog module in an Ethernet remote base, the analog update time to the CPU will be asynchronous to the scan time. Critical analog I/O should be located in the local base.

I/O point usage

The table to the right indicates the number of I/O points consumed by each module. Use this information to ensure you stay within the maximum I/O count of the I/O system you have chosen.

Module Placement Restrictions

Module/Unit	*Local CPU Base*	*Ethernet Remote Base*
CPUs	CPU slot only	
Discrete I/O	✓	✓
Analog I/O	✓	✓
Base Controller		
H2-EBC100		CPU slot only
Specialty Modules		
H2-CTRIO	✓	
H2-CTRIO2	✓	
H2-ECOM100	✓	
H2-SERIO	✓	
H2-SERIO-4	✓	
H2-ERM	✓	
F2-08SIM	✓	✓

I/O Module Point Usage

DC INPUT		*RELAY OUTPUT*		*SPECIALTY MODULES*	
D2-08ND3	8 X	D2-04TRS	8 Y[1]	F2-08SIM	8 X
D2-16ND3-2	16 X	D2-08TR	8 Y	H2-CTRIO	None
D2-32ND3	32 X	F2-08TR	8 Y	H2-CTRIO2	None
D2-32ND3-2	32 X	F2-08TRS	8 Y	H2-EBC100	None
		D2-12TR	16 Y[2]	H2-ECOM100	None
AC INPUT				H2-ERM	None
D2-08NA-1	8 X	*COMBINATION*		H2-SERIO	None
D2-08NA-2	8 X			H2-SERIO-4	None
D2-16NA	16 X	D2-08CDR	8 X/8 Y[1]		
DC OUTPUT		*ANALOG*			
D2-04TD1	8 Y[1]	F2-04AD-1	8 X/4 WX		
D2-08TD1	8 Y	F2-04AD-2	8 X/4 WX		
D2-08TD2	8 Y	F2-08AD-1	8 X/8 WX		
D2-16TD1-2	16 Y	F2-08AD-2	8 X/8 WX		
D2-16TD2-2	16 Y	F2-02DA-1(L)	2 WY		
F2-16TD1P	16 X/16 Y	F2-02DA-2(L)	2 WY		
F2-16TD2P	16 X/16 Y	F2-4AD2DA	8 X/4 WX/2 WY		
D2-32TD1	32 Y	F2-8AD4DA-1	8 X/8 WX/7 WY		
D2-32TD2	32 Y	F2-8AD4DA-2	8 X/8 WX/7 WY		
AC OUTPUT		F2-02DAS-1	2 WY		
D2-08TA	8 Y	F2-02DAS-2	2 WY		
F2-08TA	8 Y	F2-08DA-1	8 WY		
D2-12TA	16 Y[2]	F2-08DA-2	8 WY		
		F2-04RTD	8 X/4 WX		
		F2-04THM	8 X/4 WX		

Note 1: 4-pt. modules consume eight points. Only the first four points are used.
Note 2: 12-pt. modules consume 16 points. The first six points are assigned, two are skipped, and then the next six points are assigned. For example, a D2-12TA installed in slot 0 would use Y0-Y5, and Y8-Y13. Y6-Y7, and Y14-Y15 would be unused.

Base Units

Power Budget

When determining the types and quantity of I/O modules you will be using, it is important to remember there is a defined amount of power available from the base power supply.

The chart on the next page indicates the power supplied and used by each module. The adjacent chart shows an example of how to calculate the power used by your particular system. These charts should make it easy for you to determine if the devices you have chosen will operate within the power budget of your system configuration.

If the I/O you have chosen for a base exceeds the maximum power available from the power supply, you may be able to resolve the problem by using remote I/O bases.

Base power supply specifications

The table below lists base power supply specifications, including maximum inrush current and maximum power consumed from your power source.

Power budget example

The example on the right shows how to calculate the power budget for the Do-more PLC system. The examples are constructed around a single 9-slot base using the devices shown. It is recommended you construct a similar table for your Do-more PLC system. Follow the steps to the right to determine your power budget.

1. Using a chart similar to the one below, fill in column 2.
2. Using the tables on the next page, enter the current supplied and used by each device (columns 3 and 4). Devices which fall into the "Other" category (Row D) are devices such as the operator interface and the handheld programmer, which also have power requirements, but do not directly plug into the base.
3. Add the current used by the system devices (columns 3 and 4) starting with the CPU slot and put the total in the row labeled "Maximum Current Required" (Row E).
4. Subtract the row labeled "Maximum Current Required" (Row E), from the row labeled "Current Supplied" (Row B). Place the difference in the row labeled "Remaining Current Available" (Row F).
5. If "Maximum Current Required" is greater than "Current Supplied" in either column 3 or 4, the power budget will be exceeded. It will be unsafe to use this configuration, and you will need to restructure your I/O configuration. Note the auxiliary power supply does not need to supply all the external power. If you need more than the 300mA supplied, you can add an external 24V power supply. This will help keep you within your power budget for external power.

A	Column 1	Column 2	Column 3	Column 4
		Device Type	5VDC (mA)	External Power 24 VDC (mA)
B	CURRENT SUPPLIED			
	Base	9 slot	2,600	300
C	CURRENT REQUIRED			
	CPU SLOT SLOT 0 SLOT 1 SLOT 2 SLOT 3 SLOT 4 SLOT 5 SLOT 6 SLOT 7	H2-DM1E D2-16ND3-2 D2-16ND3-2 D2-16NA D2-08NA-1 D2-16TD1-2 D2-08TA D2-08TA	275 100 100 100 50 200 250 250	0 0 0 0 0 80 0 0
D	OTHER			
	Operator interface	EA1-S3ML	90	0
E	Maximum Current Required		1415	80
F	Remaining Current Available		2600-1415=1185	300-80=220

Power Supply Specifications			
Specification	AC Powered Bases	24 VDC Powered Bases	125 VDC Powered Bases
Part Numbers	D2-03B-1, D2-04B-1, D2-06B-1, D2-09B-1	D2-03BDC1-1, D2-04BDC1-1, D2-06BDC1-1, D2-09BDC1-1	D2-06BDC2-1, D2-09BDC2-1
Voltage Withstand (dielectric)	1 minute @ 1,500 VAC between primary, secondary, field ground, and run relay		
Insulation Resistance	> 10 MΩ at 500 VDC		
Input Voltage Range	85-132 VAC (110 range) 170-264 VAC (220 range) 47-63 Hz	10.2-28.8 VDC (24 VDC) with less than 10% ripple	100-264 VDC (125 VDC) with less than 10% ripple
Auxiliary 24 VDC Output	300 mA max.	none	300 mA max.
Maximum Inrush Current	30A	10A	20A
Maximum Power	80 VA	25W	30W

Base Units

Power Requirements

This section shows the amount of power supplied by each of the base power supplies and the amount of power consumed by each module. The Power Consumed charts list how much INTERNAL power from each power source is required for the modules. Use this information when calculating the power budget for your system.

In addition to the internal power sources, bases offer a 24 VDC auxiliary power supply with external power connections. This auxiliary power supply can power external devices.

Use ZipLinks to reduce power requirements

If your application requires a lot of relay outputs, consider using the *ZIP*Link AC or DC relay output modules ZL-RRL16-24-1 or ZL-RRL16-24-2. These modules can switch high current (10A) loads without putting a heavy load on your base power budget. Refer to the Terminal Blocks and Wiring Solutions section in this catalog for more information.

This logo is placed next to the I/O modules that are supported by the *ZIP*Link connection systems. See the I/O module specifications at the end of this section.

Power Supplied					
Device	**5V(mA)**	**24V Auxiliary**	**Device**	**5V(mA)**	**24V Auxiliary**
Bases			***Bases***		
D2-03B-1	2600	300	D2-04BDC1-1	2600	None
D2-04B-1	2600	300	D2-06BDC1-1	2600	None
D2-06B-1	2600	300	D2-09BDC1-1	2600	None
D2-09B-1	2600	300	D2-06BDC2-1	2600	300
D2-03BDC1-1	2600	None	D2-09BDC2-1	2600	300

Power Consumed		
Device	**5V(mA)**	**24V Auxiliary**
CPUs		
H2-DM1	250	0
H2-DM1E	275	0
DC Input Modules		
D2-08ND3	50	0
D2-16ND3-2	100	0
D2-32ND3	25	0
D2-32ND3-2	25	0
AC Input Modules		
D2-08NA-1	50	0
D2-08NA-2	100	0
D2-16NA	100	0
DC Output Modules		
D2-04TD1	60	20
D2-08TD1	100	0
D2-08TD2	100	0
D2-16TD1-2	200	80
D2-16TD2-2	200	0
F2-16TD1P	70	50
F2-16TD2P	70	50
D2-32TD1	350	0
D2-32TD2	350	0
AC Output Modules		
D2-08TA	250	0
F2-08TA	250	0
D2-12TA	350	0
Relay Output Modules		
D2-04TRS	250	0
D2-08TR	250	0
F2-08TR	670	0
F2-08TRS	670	0
D2-12TR	450	0
Combination In/Out Module		
D2-08CDR	200	0

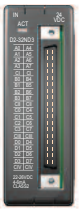
Power Consumed		
Device	**5V(mA)**	**24V Auxiliary**
Analog Modules		
F2-04AD-1	100	5
F2-04AD-2	110	5
F2-08AD-1	100	5
F2-08AD-2	100	5
F2-02DA-1	40	60 (note 1)
F2-02DA-1L	40	70 @ 12V (note 1)
F2-02DA-2	40	60
F2-02DA-2L	40	70 @ 12V
F2-02DAS-1	100	50 / channel
F2-02DAS-2	100	60 / channel
F2-08DA-1	30	50 (note 1)
F2-08DA-2	60	140
F2-4AD2DA	60	80 (note 1)
F2-8AD4DA-1	35	100 (note 1)
F2-8AD4DA-2	35	80 (note 1)
F2-04RTD	90	0
F2-04THM	110	60
Specialty Modules		
H2-CTRIO	400	0
H2-CTRIO2	275	0
H2-EBC100	300	0
H2-ECOM100	300	0
H2-ERM	320	0
H2-SERIO	80	0
H2-SERIO-4	80	0
F2-08SIM	50	0
Note 1: Add an additional 20 mA per output loop.		

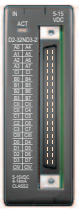
Discrete I/O Modules

The Do-more H2 Series PLC supports all discrete I/O modules available for the DL205 PLC.

D2-08ND3

D2-16ND3-2


D2-32ND3


D2-32ND3-2

D2-08NA-1

D2-08NA-2

D2-16NA

Discrete Input Modules			
Part Number	Number of Inputs	Description	Price
D2-08ND3	8	Sinking/Sourcing DC Input	<--->
D2-16ND3-2	16	Sinking /Sourcing DC Input	<--->
D2-32ND3	32	Sinking /Sourcing DC Input	<--->
D2-32ND3-2	32	Sinking /Sourcing DC Input	<--->
D2-08NA-1	8	AC input	<--->
D2-08NA-2	8	AC input	<--->
D2-16NA	16	AC input	<--->

D2-04TD1

D2-08TD1

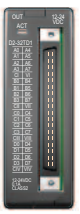
D2-08TD2

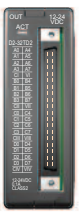
D2-16TD1-2

D2-16TD2-2

F2-16TD1P

F2-16TD2P


D2-32TD1


D2-32TD2

F2-08TA

D2-08TA

D2-12TA

D2-04TRS

D2-08TR

F2-08TR

F2-08TRS

D2-12TR

Discrete Output Modules			
Part Number	Number of Outputs	Description	Price
D2-04TD1	4	Sinking Output	<--->
D2-08TD1	8	Sinking Output	<--->
D2-08TD2	8	Sourcing Output	<--->
D2-16TD1-2	16	Sinking Output	<--->
D2-16TD2-2	16	Sourcing Output	<--->
F2-16TD1P	16	Protected Sinking Output	<--->
F2-16TD2P	16	Protected Sourcing Output	<--->
D2-32TD1	32	Sinking Output	<--->
D2-32TD2	32	Sourcing Output	<--->
F2-08TA	8	AC Output	<--->
D2-08TA	8	AC Output	<--->
D2-12TA	12	AC Output	<--->
D2-04TRS	4	Isolated Relay Output	<--->
D2-08TR	8	Relay Output	<--->
F2-08TR	8	Relay Output	<--->
F2-08TRS	8	Isolated Relay Output	<--->
D2-12TR	12	Relay Output	<--->

D2-08CDR

Discrete Input/Output Modules			
Part Number	Number of Channels	Description	Price
D2-08CDR	4/4	Sinking/Sourcing DC Input with Relay Output	<--->

For more detailed specifications and wiring diagrams, please refer to the DL205 PLC section in this catalog.

Discrete I/O Modules

The following table may be helpful for you to select the right modules for your application.

Discrete Input Modules					
Input Type	Specification	Number of Input Points per Module			
		4	8	16	32
DC (Sinking/Sourcing)	4.5 – 15.6 VDC				D2-32ND3-2
	10.2 – 26.4 VDC		D2-08ND3		
	20 – 28 VDC	D2-08CDR[1]		D2-16ND3-2	D2-32ND3
AC	80 – 132 VAC		D2-08NA-1	D2-16NA	
	170 – 265 VAC		D2-08NA-2		

Note 1: D2-08CDR is a combo I/O module that has four discrete input and four discrete output points.

Discrete Output Modules						
Output Type	Specification	Number of Output Points per Module				
		4	8	12	16	32
DC (Sinking)	4A @ 10.2 – 26.4 VDC	D2-04TD1				
	0.3A @ 10.2 – 26.4 VDC		D2-08TD1			
	0.25A @ 10.2 – 26.4 VDC				F2-16TD1P	
	0.1A @ 10.2 – 26.4 VDC				D2-16TD1-2	
	0.1A @ 12 – 24 VDC					D2-32TD1
DC (Sourcing)	0.3A @ 10.8 – 26.4 VDC		D2-08TD2			
	0.25A @ 10.2 – 26.4 VDC				F2-16TD2P	
	0.1A @ 10.2 – 26.4 VDC				D2-16TD2-2	
	0.1A @ 12 – 24 VDC					D2-32TD2
AC (SSR)	1.5A @ 24 – 140 VAC		F2-08TA			
	0.5A @ 15 – 264 VAC		D2-08TA			
	0.3A @ 15 – 132 VAC			D2-12TA		
DC/AC (Relay)	10A @ 12 – 28 VDC / 12 - 250 VAC		F2-08TR			
	7A @ 12 – 28 VDC / 12 -250 VAC		F2-08TRS			
	4A @ 5 – 30 VDC / 5 -240 VAC	D2-04TRS				
	1.5 @ 5 – 30 VDC / 5 -240 VAC			D2-12TR		
	1A @ 5 – 30 VDC / 5 -240 VAC	D2-08CDR[1]	D2-08TR			

Note 1: D2-08CDR is a combo I/O module that has four discrete input and four discrete output points.

For more detailed specifications and wiring diagrams, please refer to the DL205 PLC section in this catalog.

Analog I/O Modules

The Do-more H2 Series PLC supports all analog I/O modules available for the DL205 PLC.

F2-04AD-1

F2-04AD-2

F2-08AD-1

F2-08AD-2

F2-04RTD

F2-04THM

Analog Input Modules			
Part Number	Number of Channels	Description	Price
F2-04AD-1	4	Analog Current Input	<--->
F2-04AD-2	4	Analog Voltage Input	<--->
F2-08AD-1	8	Analog Current Input	<--->
F2-08AD-2	8	Analog Voltage Input	<--->
F2-04RTD	4	RTD	<--->
F2-04THM	4	Thermocouple	<--->

F2-02DA-1

F2-02DA-1L

F2-02DA-2

F2-02DA-2L

F2-02DAS-1

F2-02DAS-2

F2-08DA-1

F2-08DA-2

Analog Output Modules			
Part Number	Number of Channels	Description	Price
F2-02DA-1	2	Analog Current Output	<--->
F2-02DA-1L*	2	Analog Current Output	<--->
F2-02DA-2	2	Analog Voltage Output	<--->
F2-02DA-2L*	2	Analog Voltage Output	<--->
F2-02DAS-1	2	Isolated Analog Current Output	<--->
F2-02DAS-2	2	Isolated Analog Voltage Output	<--->
F2-08DA-1	8	Analog Current Output	<--->
F2-08DA-2	8	Analog Voltage Output	<--->

** F2-02DA-1L and F2-02DA-2L work with external 12VDC power instead of external 24VDC power.*

F2-4AD2DA

F2-8AD4DA-1

F2-8AD4DA-2

Analog Input/Output Modules			
Part Number	Number of Channels	Description	Price
F2-4AD2DA	4/2	Analog Current Input/Output	<--->
F2-8AD4DA-1	8/4	Analog Current Input/Output	<--->
F2-8AD4DA-2	8/4	Analog Voltage Input/Output	<--->

For more detailed specifications and wiring diagrams, please refer to the DL205 PLC section in this catalog.

Analog I/O Modules

The following table may be helpful for you to select the right modules for your application.

Analog Input Modules			
Input Type	**Specification**	**Number of Input Points per Module**	
		4	**8**
Current	0 – 20 mA		F2-8AD4DA-1 (16 bit)
	4 – 20 mA	F2-04AD-1 (12 bit) F2-4AD2DA (12 bit)	F2-08AD-1 (12 bit)
Voltage	0 – 5V, 0 – 10V, ±5V, ±10V	F2-04AD-2 (12 bit)	F2-08AD-2 (12/13 bit)
	0 – 5V, 0 – 10V		F2-8AD4DA-2 (16 bit)
	0 – 5V, 0 –156.25 mV, ±5V, ±156.25 mV	F2-04THM (16 bit)	
RTD	Pt100, Pt1000, jPt100, CU-10Ω, CU-50Ω	F2-04RTD (0.1 degree)	
Thermocouple	Type J, E, K, R, S, T, B, N, C	F2-04THM (0.1 degree)	

Analog Output Modules				
Output Type	**Specification**	**Number of Output Points per Module**		
		2	**4**	**8**
Current	4 – 20 mA	F2-02DA-1 (12 bit) F2-02DA-1L[1] (12 bit) F2-02DAS-1 (16 bit) F2-4AD2DA (12 bit)	F2-8AD4DA-1 (16 bit)	F2-08DA-1 (12 bit)
Voltage	0 – 5V, 0 – 10V, ±5V, ±10V	F2-02DA-2 (12 bit) F2-02DA-2L[1] (12 bit)		
	0 – 5V, 0 – 10V	F2-02DAS-2 (16 bit)	F2-8AD4DA-2 (15/16 bit)	F2-08DA-2 (12 bit)

Note 1: F2-02DA-1L and F2-02DA-2L work with external 12VDC power instead of external 24VDC power.

For more detailed specifications and wiring diagrams, please refer to the DL205 PLC section in this catalog.

Specialty Modules

The Do-more H2 Series PLC supports the following specialty modules.

Ethernet Communication Modules	
Part Number	**Description**
H2-ECOM100	100MBit Ethernet Communication Module
H2-ECOM (No longer available)	10Base-T Ethernet Module

Serial Communication Modules	
Part Number	**Description**
H2-SERIO	3-port RS-232 Serial I/O Module
H2-SERIO-4	3-port RS-232/RS-485 Serial I/O Module

Ethernet Remote I/O Modules	
Part Number	**Description**
H2-ERM	10Base-T Ethernet Remote Master Module
H2-EBC100	100MBit Ethernet Base Controller
H2-EBC (No longer available)	10Base-T Ethernet Base Controller

High Speed I/O Modules	
Part Number	**Description**
H2-CTRIO	High Speed Counter Interface Module
H2-CTRIO2	High Speed Counter Interface Module

Input Simulator Module	
Part Number	**Description**
F2-08SIM	8-point Input Simulator

Specialty Modules

H2-ECOM100 <--->

H2-ECOM100

Overview

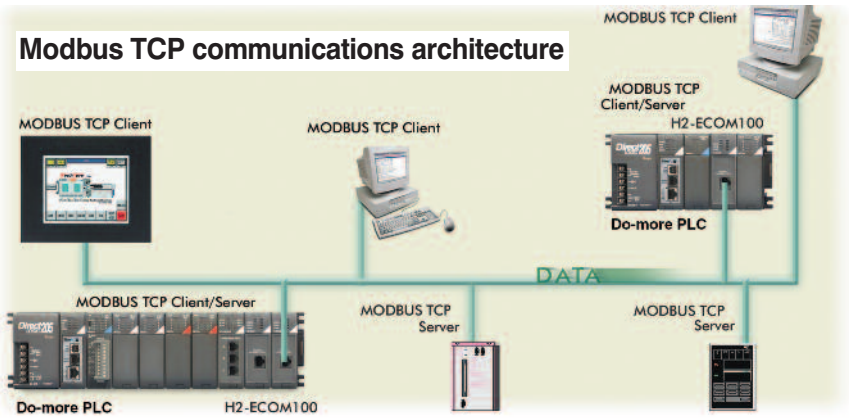
Ethernet Communications Modules offer features such as:

- High-speed peer-to-peer networking of PLCs
- Fast updates with Do-more Designer Software
- High-performance access for Human Machine Interface (HMI), ERP, MES or other Windows-based software
- Industry standard Modbus TCP Client/Server Protocol

Simple connections

Use Category 5 UTP cables which can be run up to 100 meters between nodes. If needed, use repeaters to extend distances and expand the number of nodes.

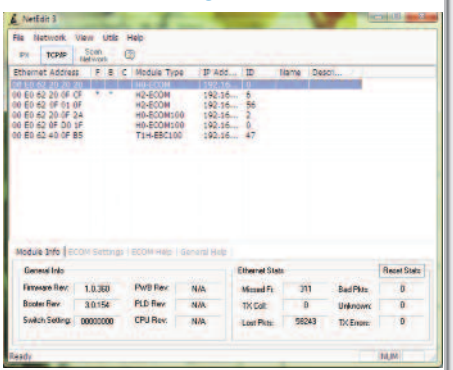
Our HA-TADP (10/100Base-T) PC network adapter card and Stride Ethernet switches are compatible with the ECOM modules. See the Communications Products section for information on these items.



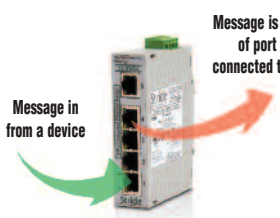
NetEdit 3 Configuration Software

NetEdit 3 Configuration Software is included in the free Do-more Designer software. Use NetEdit 3 to configure the ECOM modules for your network. Flexible addressing allows you to use your choice of protocols and identification methods. Assign each module a number, a name or both. You don't have to use an IP address, but you can if it's necessary for your network. NetEdit 3 uses two protocols for PC-to-PLC communications: IPX and TCP/IP. The NetEdit 3 screen displays all identifiers and troubleshooting information for each module on the network. You can use NetEdit 3 to adjust parameters for PLC-to-PLC communications by clicking on Advanced Settings. The network identifiers can also be changed from Do-more Designer software.

NetEdit 3 Configuration Software



The H2-ECOM100 supports the Industry Standard Modbus TCP Client/Server Protocol



See the Communications section for details on Ethernet Switches

Specifications	H2-ECOM100
Communications	10/100Base-T Ethernet
Data Transfer Rate	100 Mbps max.
Link Distance	100 meters (328 ft)
Ethernet Port	RJ45
Ethernet Protocols	TCP/IP, IPX, Modbus TCP, DHCP, HTML configuration
Power Consumption	300 mA @ 5 VDC

Specialty Modules

H2-SERIO <---->
H2-SERIO-4 <---->

H2-SERIO H2-SERIO-4

Serial I/O Modules

Add serial ports to your Do-more H2 Series PLC system by simply plugging the H2-SERIO or H2-SERIO-4 module into the base.

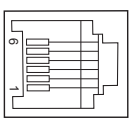
The H2-SERIO module has three RS-232 ports, while the H2-SERIO-4 module has two RS-232 ports and one RS-422/485 port.

H2-SERIO / H2-SERIO-4 Specifications		
	H2-SERIO	**H2-SERIO-4**
Module Type	Serial Communications Module	
Approvals	cUL Listed, file number E185989	
Number of Serial Ports per Module	3 ports: all RS-232 (RJ12 jack)	3 ports: 2 RS-232 ports (RJ12 jack) and 1 RS-422/485 (5 position terminal strip)
Signals	RS-232: CTS, RXD, TXD RTS, GND RTS transmision delay times: 5, 50, 250 and 500 ms	RS-232: CTS, RXD, TXD RTS, GND RTS transmision delay times: 5, 50, 250 and 500 ms
		RS-422 (4 wire) : TX+, TX-, RX-, RX+, GND RS-485 (2 wire): Data+, Data-, GND
Recommended Cables	RS-232: ZL-RJ12CBL-2	RS-232: ZL-RJ12CBL-2 RS-422: ADC L19853-x (Belden 8103) RS-485: ADC L19954-x (Belden 9842)
Protocols Supported	Do-more programming, K-sequence slave, MODBUS RTU master/slave, serial ASCII	
Power Consumption	80 mA @ 5 VDC	
Baud Rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200	
Parity	None, odd, even	
Start and Stop Bits	1, 2	
Operating Environment	0 to 60°C (32°F to 140°F), 5% to 95% RH (non-condensing); No corrosive gases, Pollution level 2; Vibration: MIL STD 810C 514.2; Shock: MIL STD 810C 516.2	
Storage Temperature	-20 to 70°C (-4°F to 158°F)	

H2-SERIO(-4) Wiring: RS-232

RS-232

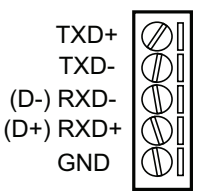
6 pin RJ12 Phone Type Jack – both ports



H2-SERIO(-4) RS-232 Pin Descriptions		
1	0V	Power (-) connection (GND)
2	CTS	Clear to Send
3	RXD	Receive data (RS-232)
4	TXD	Transmit data (RS-232)
5	RTS	Request to Send
6	0V	Signal Ground (GND)

H2-SERIO-4 Wiring: RS-422/485

RS422/485



H2-SERIO-4 RS-422 Pin Descriptions		
1	TXD+	Transmit data
2	TXD-	
3	(D-) RXD-	Receive data
4	(D+) RXD+	
5	GND	Signal Ground (GND)

H2-SERIO-4 RS-485 Pin Descriptions		
1	TXD+	N/A
2	TXD-	
3	(D-) RXD-	Transmit/Receive data
4	(D+) RXD+	
5	GND	Signal Ground (GND)

Specialty Modules

H2-ERM <--->

H2-ERM

Overview

The Ethernet Remote Master H2-ERM connects a Do-more H2 Series PLC's local CPU base to slave I/O over a high-speed Ethernet link.

Need a lot of I/O?

Each ERM module can support up to 16 additional H2-EBC systems, 16 Terminator I/O EBC systems, or 16 fully expanded H4-EBC systems. Of course, combinations are fine, too. The ERM also supports Edrives. See the Drives section for details.

Note: Applications requiring an extremely large number of T1H-EBC100 analog I/O or H4-EBC 16-channel analog I/O, could exceed the buffer capacity of a single H2-ERM module. In these cases, an additional H2-ERM may be required.

Specifications	H2-ERM
Communications	10BaseT Ethernet
Data Transfer Rate	10Mbps
Link Distance	100 meters (328 ft)
Ethernet Port	RJ45
Ethernet Protocols	TCP/IP, IPX
Power Consumption	320mA @5VDC

Simple connections

The ERM connects to your control network using Category 5 UTP cables for cable runs up to 100 meters. Use repeaters to extend distances and expand the number of nodes.

The PLC, ERM and EBC slave modules work together to update the remote I/O points. These three scan cycles are occurring at the same time, but asynchronously. Critical I/O points that must be monitored every scan are best placed in the CPU base.

Networking ERMs with other Ethernet devices

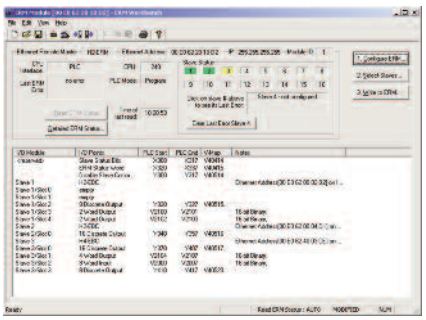
It is highly recommended that a dedicated Ethernet remote I/O network be used for the ERM and its slaves. While Ethernet networks can handle a large number of data transactions, and normally handle them very quickly, heavy Ethernet traffic can adversely affect the reliability of the slave I/O and the speed of the I/O network. Ensure ERM networks, multiple ERM networks and ECOM/office networks are isolated from one another.

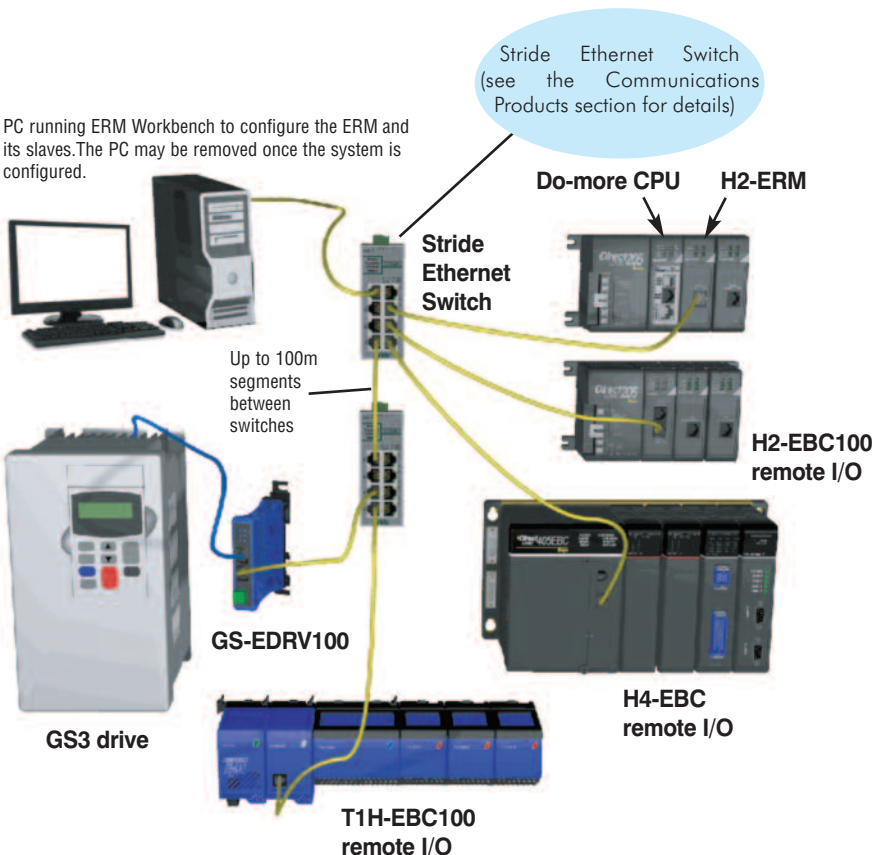
Software configuration

ERM Workbench is a software utility that must be used to configure the ERM and its remote Ethernet slaves. ERM workbench supports two methods of configuring the ERM I/O network:

- ERM Workbench PLC Wizard greatly simplifies the configuration procedure when a PLC is used as the CPU interface.
- ERM Workbench configures the I/O network whether the CPU interface is a PLC or WinPLC, and allows access to all ERM I/O network parameters.

ERM Workbench Software



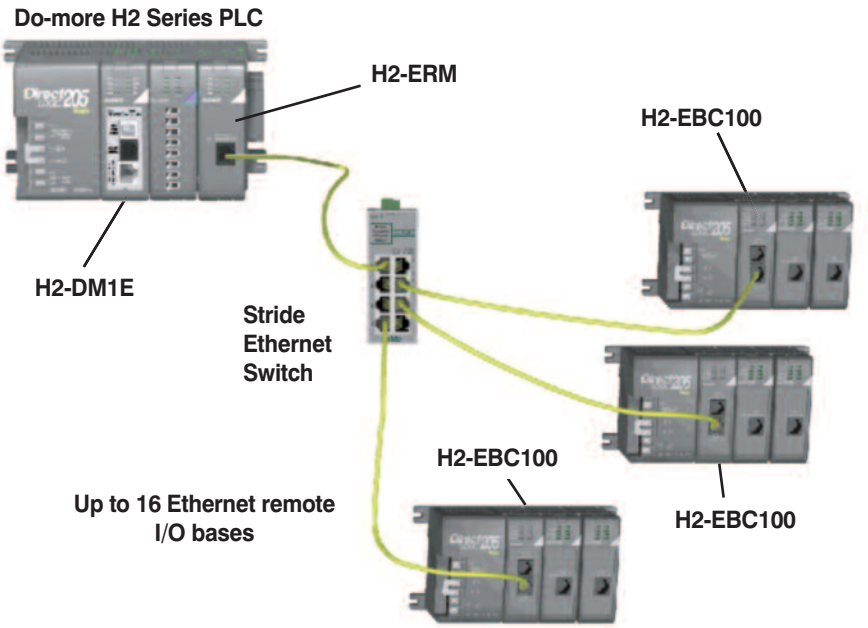

Stride Ethernet Switch (see the Communications Products section for details)
PC running ERM Workbench to configure the ERM and its slaves.The PC may be removed once the system is configured.
Do-more CPU
H2-ERM
Stride Ethernet Switch
Up to 100m segments between switches
H2-EBC100 remote I/O
GS-EDRV100
H4-EBC remote I/O
GS3 drive
T1H-EBC100 remote I/O

Specialty Modules

H2-EBC100 <--->

H2-EBC100

Specifications	H2-EBC100
Communications	10/100Base-T Ethernet
Data Transfer Rate	100 Mbps max.
Link Distance	100 meters (328 ft)
Ethernet Port / Protocols	RJ45, TCP/IP, IPX, Modbus TCP/IP, DHCP, HTML configuration
Serial Port / Protocols	RJ12, K-Sequence, ASCII IN/OUT Modbus RTU
Power Consumption	300 mA



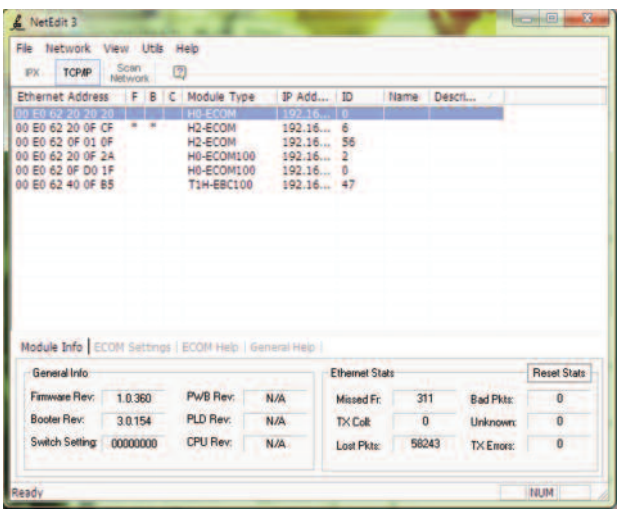
Use EBCs for Ethernet remote I/O slaves

The H2-EBC100 Ethernet Base Controller module provides a low-cost, high-performance Ethernet link for the Do-more H2 Series PLC using the H2-ERM module and Ethernet remote I/O. The H2-EBC100 supports industry standard 10/100BaseT Ethernet communications and is compatible with TCP/IP, IPX and Modbus TCP/IP protocols for flexible PC communications.

Easy to use, reliable and fast

The H2-EBC100 module plugs into the CPU slot of any DL205 I/O base and supports all DL205 discrete and analog I/O modules. All EBC modules can be configured using NetEdit 3, included in the free Do-more Designer software. The H2-EBC100 also supports HTML configuration.

NetEdit 3 Configuration Software


NetEdit 3
File Network View Utils Help
IPX TCP/IP Scan Network
Ethernet Address F B C Module Type IP Add... ID Name Descri...
00 E0 62 20 20 20 H0-ECOM 192.16... 0
00 E0 62 20 0F CF H2-ECOM 192.16... 6
00 E0 62 0F 01 0F H2-ECOM 192.16... 56
00 E0 62 20 0F 2A H0-ECOM100 192.16... 2
00 E0 62 0F D0 1F H0-ECOM100 192.16... 0
00 E0 62 40 0F B5 T1H-EBC100 192.16... 47
Module Info ECOM Settings ECOM Help General Help
General Info
Firmware Rev: 1.0.360
Booter Rev: 3.0.154
Switch Setting: 00000000
PWB Rev: N/A
PLD Rev: N/A
CPU Rev: N/A
Ethernet Stats
Reset Stats
Missed Fr: 311
TX Coll: 0
Lost Pkts: 56243
Bad Pkts: 0
Unknown: 0
TX Errors: 0
Ready
NUM

Specialty Modules

H2-CTRIO <---->
H2-CTRIO2 <---->

H2-CTRIO H2-CTRIO2

Overview

The H2-CTRIO and H2-CTRIO2 Counter I/O modules are designed to accept high-speed pulse input signals for counting or timing applications. These modules also provide high-speed pulse output signals for servo/stepper motor control, monitoring and alarming as well as other discrete control functions.

The CTRIO(2) module offers greater flexibility for applications which call for precise counting or timing based on input events or for high speed control output applications. It can also be used for applications that call for a combination of both high-speed input and high-speed output control functions.

The CTRIO(2) module has its own microprocessor and operates asynchronously with respect to the CPU. Therefore, the response time of the on-board outputs is based on the module's scan time, not the CPU's scan time.

Software Configuration

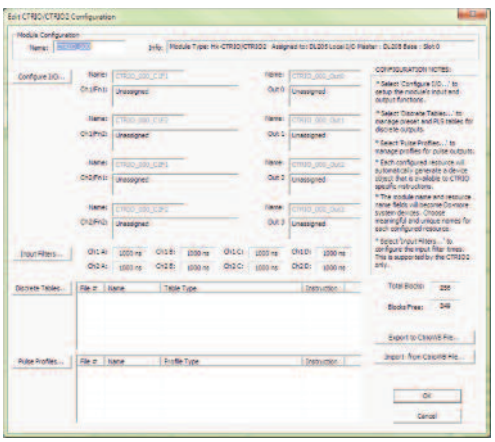
All scaling and configuration is done from within the Edit CTRIO/CTRIO2 Configuration window of Do-more Designer. This eliminates the need for PLC ladder programming or other interface device programming to configure the module.

General Specifications		
Specifications	**H2-CTRIO**	**H2-CTRIO2**
Discrete I/O Points Used	None (I/O map directly in H2-DM1/E data structure)	
Base Power Required	400 mA Max	275 mA Max
Isolation	2500V I/O to Logic, 1000V among Input Channels and All Outputs	1500V I/O to Logic, 1000V among Input Channels and All Outputs

Input Specifications		
Specifications	**H2-CTRIO**	**H2-CTRIO2**
Inputs	8 pts sink/source	
Maximum Input Frequency	100 kHz	250 kHz
Minimum Pulse Width	5 µsec	0.5 µsec
Input Voltage Range	9-30 VDC	9-30 VDC
Maximum Voltage	30 VDC	
Input Voltage Protection	Zener Clamped at 33 VDC	
Rated Input Current	8 mA typical 12 mA maximum	
Minimum ON Voltage	9.0 VDC	
Maximum OFF Voltage	2.0 VDC	
Minimum ON Current	5.0 mA	
Maximum OFF Current	2.0 mA	
OFF to ON Response	Less than 3 µsec	Less than 0.5 µsec
ON to OFF Response	Less than 3 µsec	Less than 0.5 µsec

Output Specifications		
Specifications	**H2-CTRIO**	**H2-CTRIO2**
Outputs	4 pts (sink/source), independently isolated	
Pulse Outputs	2 channels, 20 Hz to 25 kHz Pulse/Direction or CW/CCW	2 channels, 20 Hz to 250 kHz Pulse/Direction or CW/CCW
Minimum Pulse Width	5 µsec	0.5 µsec
Output Voltage Range	5-36 VDC	
Maximum Output Voltage	36 VDC	
Maximum Load Current	1.0 A	1.0 A at 23°C 0.5 A at 60°C
Maximum Leakage Current	100 µA	
Inrush Current	5.0 A for 20 ms	2.0 A for 10 ms
ON State V Drop	0.3 VDC or less	0.45 VDC or less
Overcurrent Protection	Yes	
OFF to ON Response	less than 3 µsec	less than 1 µsec
ON to OFF Response	less than 3 µsec	less than 1 µsec

Edit CTRIO/CTRIO2 Configuration Window



Inputs Supported:

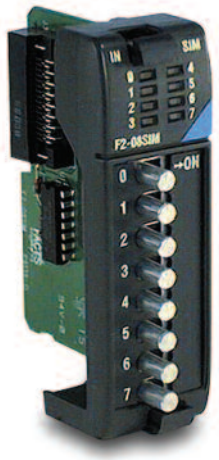
- Counter
- Quad Counter
- Pulse Catch
- Edge Timer
- Dual Edge Timer

Outputs Supported:

- Pulse train - used for servo/stepper motor control. Configurable for CW/CCW or step and direction
- Discrete outputs - assigned to Counter/Timer input functions
- Raw output - outputs controlled directly from the CPU interface program
- Programmable limit switch

Specialty Modules

F2-08SIM <--->



F2-08SIM

F2-08SIM Input Simulator	
Inputs per Module	8
Base Power Required 5VDC	50 mA
Terminal Type	None
Status Indicator	Switch side
Weight	2.65 oz. (75 g)

Dimensions and Installation

Understanding the installation requirements for your Do-more H2 Series PLC system will help ensure that the components operate within their environmental and electrical limits.

Plan for safety

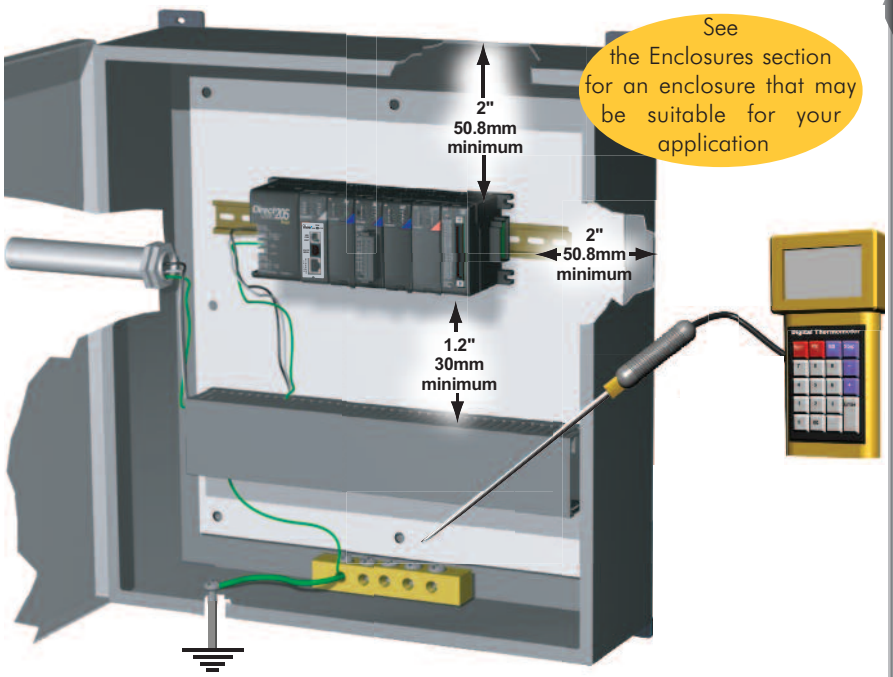
This catalog should never be used as a replacement for the user manual. The user manual, H2-DM-M (sold separately or downloadable online), contains important safety information that must be followed. The system installation should comply with all appropriate electrical codes and standards.

Environmental specifications

The Environmental Specifications table at the right lists specifications that apply globally to the Do-more H2 Series PLC system (CPUs, bases, and I/O modules). Be sure that the system is operated within these environmental specifications.

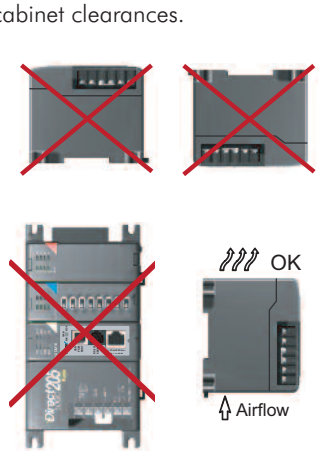
Base dimensions and mounting

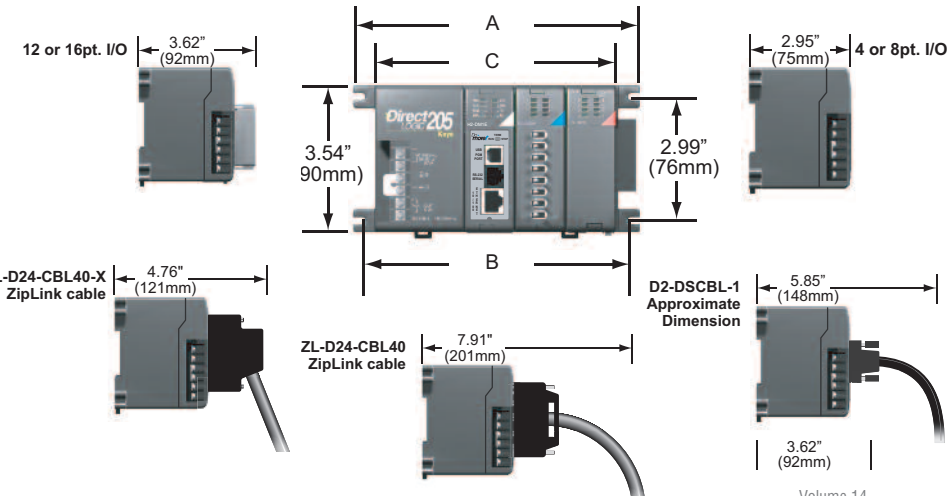
Use the diagrams below to make sure the Do-more H2 Series PLC system can be installed in your application. To ensure proper airflow for cooling purposes, bases must be mounted horizontally. It is important to check these dimensions against the conditions required for your application. For example, it is recommended that approximately 3" of space is left in front PLC surface for ease of access and cable clearances. Also, check the installation guidelines for recommended cabinet clearances.



Environmental Specification	Rating
Storage Temperature	-4°F - 158°F (-20°C to 70°C)
Ambient Operating Temperature	32°F - 131°F (0°C to 55°C)
Ambient Humidity	30%-95% relative humidity (non-condensing)
Vibration Resistance	MIL STD 810C, Method 514.2
Shock Resistance	MIL STD 810C, Method 516.2
Noise Immunity	NEMA (ICS3-304)
Atmosphere	No corrosive gases

Base	A (Base Total Width)		B (Mounting Hole)		C (Component Width)	
	Inches	*Millimeters*	*Inches*	*Millimeters*	*Inches*	*Millimeters*
3-slot	6.77"	172mm	6.41"	163mm	5.8"	148mm
4-slot	7.99"	203mm	7.63"	194mm	7.04"	179mm
6-slot	10.43"	265mm	10.07"	256mm	9.48"	241mm
9-slot	14.09"	358mm	13.74"	349mm	13.14"	334mm





Wiring Solutions

Wiring Solutions using the *ZIP*Link Wiring System

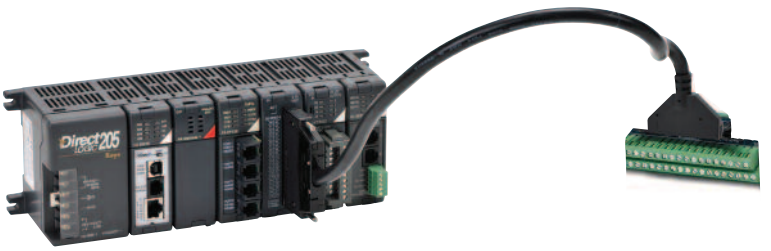
*ZIP*Links simplify the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. It's as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using half the space at a fraction of the cost of standard terminal blocks. There are several wiring solutions available when using the *ZIP*Link System ranging from PLC I/O-to-*ZIP*Link Connector Modules that are ready for field termination, options for connecting to third party devices, GS, DuraPulse and SureServo Drives, and specialty relay, transorb and communications modules. Pre-printed I/O-specific adhesive label strips for quick marking of *ZIP*Link modules are provided with *ZIP*Link cables. See the following solutions to help determine the best *ZIP*Link system for your application.

Solution 1: Do-more H2 Series PLC to *ZIP*Link Connector Modules

When looking for quick and easy I/O-to-field termination, a *ZIP*Link connector module used in conjunction with a prewired *ZIP*Link cable, consisting of an I/O terminal block at one end and a multi-pin connector at the other end, is the best solution.

Using the PLC I/O Modules to *ZIP*Link Connector Modules selector tables located in this section,

1. Locate your I/O module/PLC.
2. Select a *ZIP*Link Module.
3. Select a corresponding *ZIP*Link Cable.

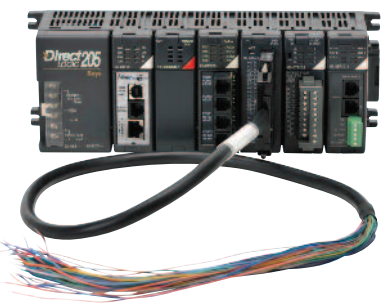


Solution 2: Do-more H2 Series PLC to 3rd Party Devices

When wanting to connect I/O to another device within close proximity of the I/O modules, no extra terminal blocks are necessary when using the *ZIP*Link Pigtail Cables. *ZIP*Link Pigtail Cables are prewired to an I/O terminal block with color-coded pigtail with soldered-tip wires on the other end.

Using the I/O Modules to 3rd Party Devices selector tables located in this section,

1. Locate your PLC I/O module.
2. Select a *ZIP*Link Pigtail Cable that is compatible with your 3rd party device.



Solution 3: GS Series and DuraPulse Drives Communication Cables

Need to communicate via Modbus RTU to a drive or a network of drives?

*ZIP*Link cables are available in a wide range of configurations for connecting to PLCs and *Sure*Servo, *Sure*Step, Stellar Soft Starter and AC drives. Add a *ZIP*Link communications module to quickly and easily set up a multi-device network.

Using the Drives Communication selector tables located in this section,

1. Locate your Drive and type of communications.
2. Select a *ZIP*Link cable and other associated hardware.

Solution 4: Serial Communications Cables

*ZIP*Link offers communications cables for use with Do-more H2 Series CPUs, that can also be used with other communications devices. Connections include a 6-pin RJ12 or 9-pin, 15-pin and 25-pin D-sub connectors which can be used in conjunction with the RJ12 or D-Sub Feedthrough modules.

Using the **Serial Communications Cables** selector table located in this section,

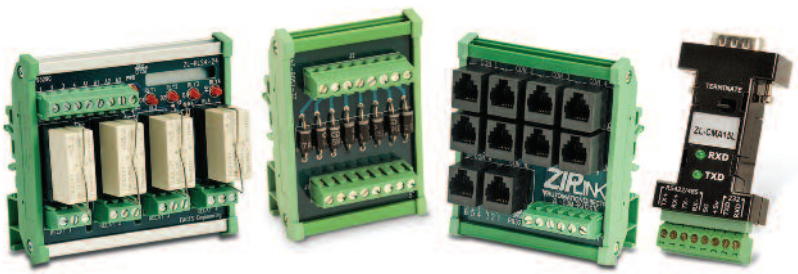
1. Locate your connector type
2. Select a cable.

Solution 5: Specialty *ZIP*Link Modules

For additional application solutions, *ZIP*Link modules are available in a variety of configurations including stand-alone relays, 24VDC and 120VAC transorb modules, D-sub and RJ12 feedthrough modules, communication port adapter and distribution modules, and *Sure*Servo 50-pin I/O interface connection.

Using the ***ZIP*Link Specialty Modules** selector table located in this section,

1. Locate the type of application.
2. Select a ZIPLink module.



Solution 6: *ZIP*Link Connector Modules to 3rd Party Devices

If you need a way to connect your device to terminal blocks without all that wiring time, then our pigtail cables with color-coded soldered-tip wires are a good solution. Used in conjunction with any compatible *ZIP*Link Connector Modules, a pigtail cable keeps wiring clean and easy and reduces troubleshooting time.

Using the **Universal Connector Modules and Pigtail Cables** table located in this section,

1. Select module type.
2. Select the number of pins.
3. Select cable.

ZIPLink Wiring Solutions

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Do-more PLC Input Module ZIPLink Selector				
PLC		ZIPLink		
Input Module	# of Terms	Component	Module	Cable †
D2-08ND3	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-16ND3-2	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Sensor	ZL-LTB16-24	ZL-D2-CBL19*
D2-32ND3[1]	40	Feedthrough	ZL-RTB40	ZL-D24-CBL40*
				ZL-D24-CBL40*X
		Sensor	ZL-LTB32-24	ZL-D24-CBL40*
				ZL-D24-CBL40*X
D2-32ND3-2[1]	40	Feedthrough	ZL-RTB40	ZL-D24-CBL40*
				ZL-D24-CBL40*X
		Sensor	ZL-LTB32-24	ZL-D24-CBL40*
				ZL-D24-CBL40*X
D2-08NA-1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-08NA-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-16NA	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*

Do-more PLC Analog Module ZIPLink Selector				
PLC		ZIPLink		
Analog Module	# of Terms	Component	Module	Cable
F2-04AD-1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08AD-1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-04AD-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08AD-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-02DA-1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-02DA-1L	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-02DAS-1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08DA-1	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
F2-02DA-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-02DA-2L	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-02DAS-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08DA-2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-4AD2DA	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-8AD4DA-1	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
F2-8AD4DA-2	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
F2-04RTD[2]	Matched Only	See Note 2		
F2-04THM[2]	Matched Only	See Note 2		

Do-more PLC Combo In/Out Module ZIPLink Selector				
PLC		ZIPLink		
Combo Module	# of Terms	Component	Module	Cable
D2-08CDR	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*

Do-more PLC Output Module ZIPLink Selector				
PLC		ZIPLink		
Output Module	# of Terms	Component	Module	Cable †
D2-04TD1[3]	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-08TD1	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-08TD2	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-16TD1-2	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Fuse	ZL-RFU20[5]	ZL-D2-CBL19*
		Relay	ZL-RRL16-24-1	ZL-D2-CBL19*
D2-16TD2-2	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Fuse	ZL-RFU20[5]	ZL-D2-CBL19*
		Relay	ZL-RRL16-24-2	ZL-D2-CBL19*
F2-16TD1P	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Relay	ZL-RRL16-24-1	ZL-D2-CBL19*
F2-16TD2P	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Relay	ZL-RRL16-24-2	ZL-D2-CBL19*
D2-32TD1[1]	40	Feedthrough	ZL-RTB40	ZL-D24-CBL40*
				ZL-D24-CBL40*X
		Fuse	ZL-RFU40[5]	ZL-D24-CBL40*
				ZL-D24-CBL40*X
D2-32TD2[1]	40	Feedthrough	ZL-RTB40	ZL-D24-CBL40*
				ZL-D24-CBL40*X
		Fuse	ZL-RFU40[5]	ZL-D24-CBL40*
				ZL-D24-CBL40*X
D2-08TA	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08TA	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-12TA	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Fuse	ZL-RFU20[5]	ZL-D2-CBL19*
D2-04TRS[3]	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-08TR	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
F2-08TRS[3]	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
F2-08TR[4]	10	Feedthrough	ZL-RTB20	ZL-D2-CBL10*
D2-12TR	19	Feedthrough	ZL-RTB20	ZL-D2-CBL19*
		Fuse	ZL-RFU20[5]	ZL-D2-CBL19*

† X in the part number represents a 45° angle plug

** Select the cable length by replacing the * with: Blank = 0.5m, -1 = 1.0m, or -2 = 2.0m.*

1 To make a custom cable for the 32-point modules, use: Ribbon-style Connector ZL-D24-CON-R, Solder-style 180° connector ZL-D24-CON or Solder-style 45° connector ZL-D24-CON-X.

2 The F2-04RTD and F2-04THM modules are not supported by the ZIPLink wiring system.

3 Caution: The D2-04TD1, D2-04TRS, and F2-08TRS outputs are derated not to exceed module specs 2A per point and 2A per common when used with the ZIPLink wiring system.

4 The F2-08TR outputs are derated not to exceed 2A per point and 4A per common when used with the ZIPLink wiring system.

5 Note: Fuses (5 x 20 mm) are not included. See Edison Electronic Fuse section for (5 x 20 mm) fuse. S500 and GMA electronic circuit protection for fast-acting maximum protection. S506 and GMC electronic circuit protection for time-delay performance. Ideal for inductive circuits. To ensure proper operation, do not exceed the voltage and current rating of ZIPLink module. ZL-RFU20 = 2A per circuit; ZL-RFU40 = 400 mA per circuit.

NOTE: ZIPLINK CONNECTOR MODULES AND ZIPLINK CABLES SPECIFICATIONS ARE IN THE ZIPLINK CATALOG SECTION.